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DRAFT REPORT

ANNEX SITE HOUSING PROTOTYPE STUDY

ALAMEDA NAS

SEDWAY COOKE ASSOCIATES

NOVEMBER 30, 1967

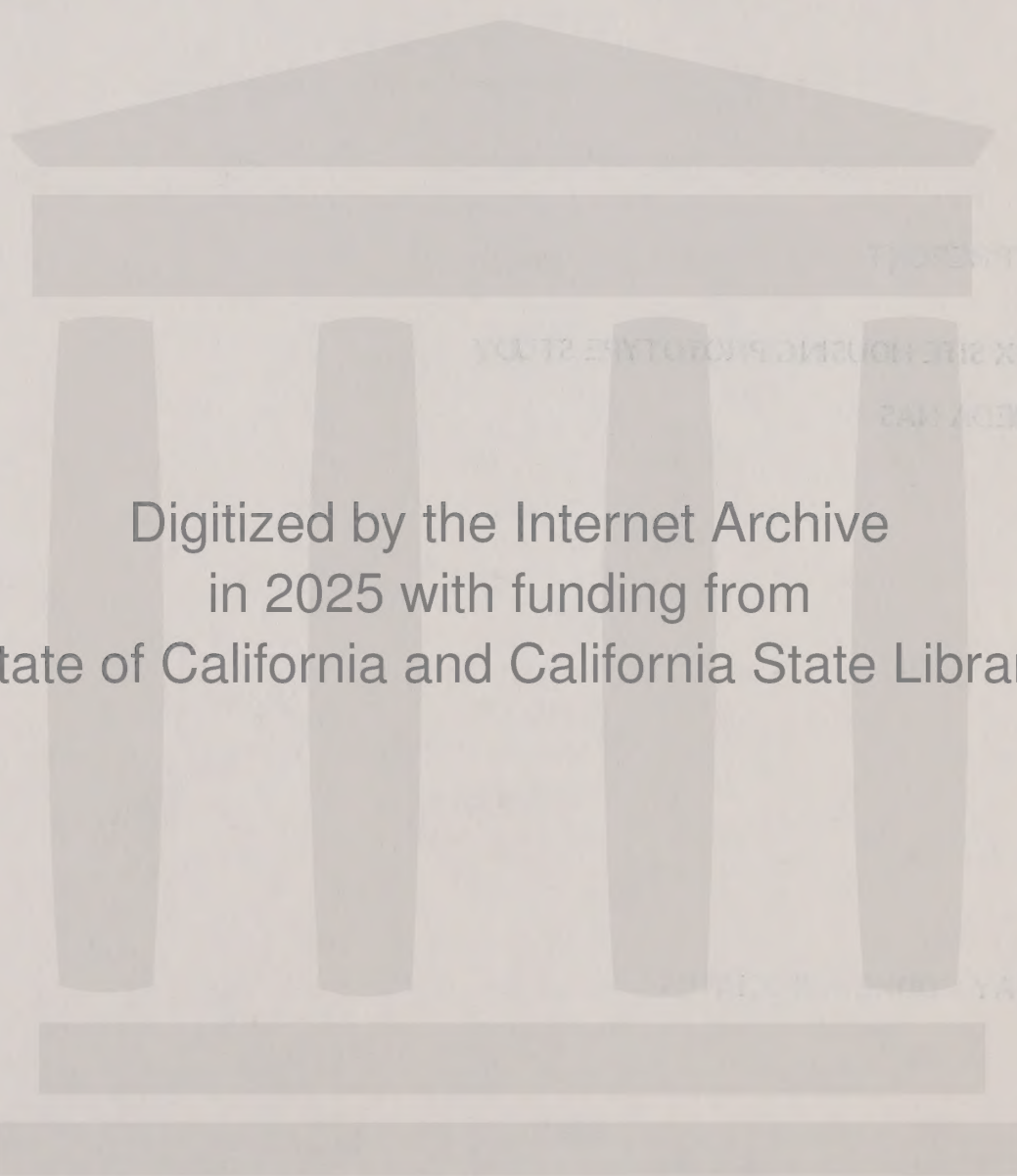
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I. STUDY PURPOSE

The City of Alameda mandates that all residential development in the City be either single family houses or duplex units, duplex units being the only multi-family development allowed within the City. However, since the Alameda Annex site is controlled by the Navy, it, in the legal sense, is outside the City's jurisdiction, and therefore not bound by the restriction on multi-family development. Nevertheless, it is the Navy's desire, to the degree possible, to meet the intent of the City's housing policy.

Due to the increasing shortage of housing for Navy personnel in the Bay Area, the Alameda Annex site has been programmed for the development of 960 housing units, in three phases. The Annex site consists of 74 acres of land; the resulting density would be 12.9 housing units per acre as compared to seven or less housing units per acre in other areas of the Alameda Naval Air Station. The Navy's personnel housing traditionally has taken the form of multi-family housing, consisting of 6-8 housing units per structure. With an increase in the target density and a desire to reduce the number of housing units per structure to two, to be compatible with the City's policy, the following questions need to be considered:

- o Is it possible for the Annex site to accommodate all the housing units programmed in the form of duplexes? If not, what will be the shortfall?
- o Is it possible to maintain an acceptable housing standard despite the higher density proposed?

II. CITY OF ALAMEDA HOUSING DEVELOPMENT POLICIES

- o What will be the cost of construction of duplexes as compared to multi-family housing with 6-8 units per structure?
- o How much land will be required to build duplex housing as compared to the more conventional multi-family housing?
- o Can multi-family housing be designed in a way more acceptable to the City?
- o What are the alternatives to satisfying the entire housing program on-site?

The purpose of the Alameda Naval Air Station Annex Site Housing Prototype Study is to find the optimum use of the Annex site, identify housing solutions which respect the City's housing objectives without compromising the Navy's need to provide adequate housing for its personnel, and provide a basis for structuring a housing development package when the time is ripe for its implementation.

II. CITY OF ALAMEDA HOUSING DEVELOPMENT POLICIES

An important housing development policy of the City of Alameda is that no multiple (multi-family) dwelling units are allowed to be built within the City. City Planning staff emphasized this point during a meeting on October 12, 1987, where Planning Director Jonas Arnold and Community Development Director Donna Howard presented the City's concerns regarding the Navy's proposal to develop the Annex site for housing.

On March 13, 1973, Measure A, an initiative amendment to the City's Charter, was passed; it states that there shall be no multiple dwelling units built in the City of Alameda. City Planning staff indicated that the initiative's major concern is to protect the quality of the City's living conditions from the adverse effects of increased land use densities. The intent is to prohibit construction of more than two dwelling units within the same structure. City Planning staff also indicated that the building height limit for residential structures in Alameda is two stories, and not to exceed 30 feet from grade to ridgeline.

The Annex site is currently zoned by the City of Alameda as Industrial. City zoning regulations would require a zone amendment to allow residential development on the site. City staff indicated that the Annex site potentially could be developed for residential use at a density of 12.5 dwelling units per gross acre. To achieve this potential density for the site under the City's policy of duplex housing, a Planned Development application would have to be approved.

The City's procedure for applying for a Planned Development District is briefly outlined below.

The City Planning Board is responsible for reviewing Planned Development applications and recommending approval or disapproval to the City Council for final action. Appeals of the Board's recommendations are made to the City Council.

The application process consists of a "pre-application" meeting with City Planning staff to review the Development Plan. This initial meeting establishes the scope of the project and identifies the primary concerns of the City, which must be addressed in the application.

The next step is to submit the application and a Development Plan for review by City staff. This review process generally takes six weeks. The application then is scheduled for a public hearing with the Planning Board. Depending on the scope of the project and the amount of public testimony, the Board may continue the hearing process. The public hearing process could take 2-4 weeks. The Board also could refer the application to the Design Review Board for a report or for its approval.

After public testimony is completed, the Board prepares its recommendations for City Council action. The Board may impose conditions to eliminate or mitigate any of the following conditions which might result from approval of the application:

- o Traffic congestion or unsafe access.
- o Site not physically suitable for the type of development.

- o Site not physically suitable for the proposed density.
- o Proposed improvements which may cause environmental damage.
- o Designs or types of improvement which may cause serious public health problems.

This portion of the process may take 6-8 weeks; afterward, the recommendations are forwarded to the City Council.

The Development Plan as amended and approved by the Planning Board is the Final Plan for the project. This plan consists of a site plan showing:

- o All streets, walkways, waterways, bicycle or pedestrian paths, parking lots, dividing strips, bridges, building pads or sites, and lot lines.
- o Areas proposed to be reserved for parks, playgrounds, school sites, public buildings, and similar public uses.
- o General topography and cross-section information.

The Final Plan also includes a plot plan showing:

- o Each building site or pad, in relation to other building sites in distance and approximate location of all buildings, structures, and improvements.
- o All open space, including common open space and private open space.

- o Elevations, perspective drawings, models, or other graphic representations of the project.

A development schedule is to be included as part of the Final Plan. This schedule is to indicate the approximate date construction will begin and the approximate dates when each stage or phase of development is expected to be completed.

The Navy's Master Plan for the Annex site should address the City's concerns over traffic congestion and access, appropriate design and density for the site, and potential environmental and public health effects outlined in the Planned Development procedure. The Master Plan also should include a development schedule for the site.

An Environmental Impact Assessment for the Master Plan should address the City's Planned Development issues of land use and aesthetics, traffic and access, utility services including storm drainage, and environmental health. These issues should be addressed with regard to both on-site and off-site impacts. This would allow the City and the general public the opportunity to comment on the proposed housing project. The assessment would establish the project's impacts and identify the level of the next environmental review of the Master Plan.

Although it is important for the Navy to consider local concerns regarding development of its facilities, it would be inappropriate for the Navy to have to apply for a zone amendment with the City of Alameda to develop Navy housing on Station property. Development on the Alameda Naval Air Station is outside of the jurisdiction of the City and therefore not bound by the City's restriction on multi-family development. The Navy's housing requirements should be given a higher priority than

the City's housing policy. The Navy and the City of Alameda share the common housing objective of providing a quality living environment for residents. To achieve this, the Navy and the City need to coordinate their planning efforts.

Along with the Navy's formal A-95 procedure for notifying the City of its development intentions, more informal methods are encouraged. The City needs to be informed of the Station's long-range planning decisions regarding changes in land use, traffic, and utility services, because of impacts on the City's future planning and capital improvement programs.

III. CRITIQUE ON NAVY HOUSING STANDARDS

The Alameda Naval Air Station Annex Site Housing Prototype Study is based on housing standards outlined in NAVFAC Specification No. 12-83-2553 (200 family housing units at the Naval Complex in San Diego) on the assumption that similar housing types could be developed on the Annex site. This chapter will examine Navy-adopted design standards from the standpoint of the quality of housing as a result of applying these standards; and critique their applicability to the Annex site. Among the many aspects of good-quality housing, the most important have to do with the liveability of the environment, further discussed under the following subjects: density; circulation and parking; streetscape; privacy; lighting and ventilation; useable open space; security; and neighborhood compatibility

Density

The average site density resulting from full implementation of the target housing program of 960 housing units would be 12.9 housing units per acre. This density is slightly higher than the City of Alameda's expected development density of 12.5 housing units per acre for duplexes, but falls within the Navy's programmed density of 12-15 housing units per acre. Due to the shortage of available Bay Area land and the increasing housing needs of Navy personnel, it is not an unreasonable target density. However, current Navy standards (NAVFAC Specification No. 12-83-2553) call for development at a much lower density, 5.8 housing units per acre. Assuming these are minimum standards, and should be adhered to as much as possible, the

Annex site would require a very efficient use of land, creative design of housing units, and cluster plans to achieve desirable results.

Densities contribute to the perceived quality of a living environment. Current Navy standards consist of very few, if any, stipulations on design measures that could help create a perception of low density and thus a more liveable environment. Design measures have proved to be effective and have yielded satisfactory results in many private and public housing developments. The following are a few examples of such design measures:

- o Avoid long unbroken building facades.
- o Avoid single box building form.
- o Avoid long corridors or access balconies.
- o Encourage building facade articulation and division to reflect human scale.
- o Encourage recognition of individual housing units.
- o Encourage individual entrances.
- o Encourage balconies and private patios.

Circulation and Parking

Current Navy standards contain provisions dealing with circulation and parking. Other major circulation elements, such as area-wide pedestrian walkways, bicycle paths, and collector roadways, are not included as part of this study. The issues pertaining to vehicular access to housing areas, and the relationship between the housing units and their associated parking are summarized as follows:

1. The current standards emphasize convenience by limiting the distance between the housing unit and its associated parking to 25-50 feet. This limit would dictate a more dispersed parking system, which would require more land area for parking and internal circulation than would be possible if the objective were to meet the entire target housing program on the Annex site. Therefore, it is appropriate to adopt a standard that would relax the distance limitation and allow centralized parking to economize the use of the site.
2. To compensate for increased walking distances (about 50-200 feet) as proposed in the housing prototype designs, it is necessary to improve the quality of pedestrian walkways and open space with landscaping and other design treatments. The greater concentration of cars in the parking areas would require landscaping improvements of the parking areas, which also should be screened from view.
3. Due to the considerable number of compact cars used by Navy personnel, it seems appropriate to consider providing compact car spaces as a percentage of total parking requirements. This policy would reduce the land area used for parking and increase the land area available for housing.

Streetscape

Streetscape is an integral part of the living environment and should not be treated lightly. Current Navy standards for streetscape design are inadequate; design standards in the following areas should be strengthened:

1. Street Design, including walkways, landscaping strips, street trees and other planting materials, lighting for motorists and pedestrians, curb cut standards and frequencies, pedestrian crossings, and other street furniture.
2. Front Yard Design, including grass and paved areas, fences and enclosures, landscaping standards and materials, entrances, and walkways.
3. Major Pedestrian Walkways and Bicycle Paths, including design, landscaping, and relationship to housing areas and to major on-site open space.
4. Major On-site Open Space, including design, landscaping, and relationship to housing areas and to other community facilities.

Privacy

Whereas privacy usually is not a problem in low-density housing, it would require a more skillful approach in designing and siting buildings and their intervening space to achieve a satisfactory result when the density increases. Current Navy standards control distances between opposing window walls as a means to achieve privacy in housing units; this is a sound and flexible approach to ensure privacy. However, in the Annex site, due to the higher target density necessary to accommodate all programmed housing units, it is necessary to introduce additional measures to safeguard privacy. As shown in the housing prototype design in the following chapter, privacy can be achieved through a combination of distance control between opposing walls, window design and placement, siting of buildings in relation to each other, visual

screening by fencing and landscaping, interior space planning, noise insulation, and grade separation if possible. No standards other than the distance between opposing walls are included in current Navy design standards.

It is recommended that the design of housing units and clusters should include the following:

1. Define primary living space (such as living room, dining room, family room space used heavily most of the day), secondary living space (such as bedroom, work space, kitchen), and service areas (such as corridors, hallways, storage, bathroom), so that a hierarchy of space can be established based on privacy needs.
2. Give a high priority for privacy to all primary living space in planning housing units, using service areas for intervention and protection against intrusion.
3. Site buildings and place windows to avoid face-to-face arrangements, to safeguard views and privacy.
4. Increase the minimum distances between opposing walls in direct proportion to the need for privacy if windows exist on both walls, as recommended in Table I.
5. Offset opposing windows requiring privacy treatment from each other when possible; use small, high windows; or incorporate horizontal or vertical projections to discourage and block direct views from one window to another.

6. Allow opposing windowless walls or walls with high windows only with less intervening space to make building siting more flexible and to achieve a more efficient use of land.

Lighting and Ventilation

Current Navy housing standards contain provisions for lighting and ventilation stipulated in the Uniform Building Code and other building and housing codes. The recommendations in the previous section with respect to minimum distances between opposing windows and walls also will provide additional assurance for adequate lighting and ventilation of housing units. To augment these standards, it is important to include a provision controlling orientation of the living space. Major openings to primary living space should have a south orientation, for lighting and for allowing direct sunlight in winter as much as possible. A north orientation is not recommended for window openings in the primary living space. Balconies, patios, and other outdoor living spaces should be located on the south side and be directly accessible from the primary living space to ensure desirable climatic conditions for outdoor activities. Less desirable orientations may be acceptable for windows in other living space and service areas, due to their activities and to their being used less often during the day (see Table 2).

Table 1

DISTANCE STANDARDS FOR FACING WINDOWS

	ON-SITE			AT CLUSTER BOUNDARY		
Window Openings to:	Primary Living Space	Secondary Living Space/ Service Area	Blank Wall	FRONT	BACK	*** SIDE
Primary Living Space	40'*	30'	15'	20'	20'	10'
Secondary Living Space / Service Area		15'	10'	10'	10'	7.5'
Blank Wall **			7.5'			7.5'

* Windows serving units on ground level may be 30 feet apart if they are visually separated by a fence at a height of 5'-6" minimum above ground level.

** Including walls with high windows or other devices to block direct views from the public or other housing units.

*** Assuming high windows only.

Table 2

WINDOW ORIENTATION RECOMMENDATION

Window Openings to:	East	South	West	North
Primary Living Space	YES	GOOD	YES	NO
Secondary Living Space/ Service Areas [*]	YES	GOOD	YES	YES

* With or without windows, service areas in the north and west would provide additional solar insulation to the housing unit during summer months.

Useable Open Space

On-site open space serves many functions. The most important are:

- o It provides lighting and ventilation for interior spaces.
- o It provides privacy to units and allows them to be separated physically.
- o It accommodates on-site circulation.
- o It establishes useable space and facilities for outdoor living and recreation.

The first three functions are discussed in other sections of this study. This section deals specifically with the useability of on-site open space for outdoor living and recreation.

Outdoor recreation and living spaces are important amenities in residential development. The amount of useable open space provided on-site should vary according to the type and density of the housing development. Current Navy housing standards provide yard space, private patios, and balconies for units. Those standards on minimum dimension and area are considered adequate for outdoor living and recreation. However, there are important deficiencies relating to quality of on-site open space. An example of poor-quality open space can be found locally in the existing Navy housing north and south of the Annex site. Compared to the target density for the Annex site, existing housing areas were developed at a much lower density. The large amount of open space in between buildings rarely serves the recreation functions due to its unattractive character, and the feeling that it is undefined space belonging to no particular groups of users.

The design of useable open space should take into consideration its intended use. In general terms, there are two kinds of open space:

- o Private open space, such as patios, balconies, porches, which are extensions to indoor living space; and
- o Common open space, such as entrance courts, pedestrian walkways, common yard spaces, play-lots shared by a particular group of housing units for recreation, outdoor living, and socializing.

For private open space design, it is important to consider the following aspects:

- o Size and dimension;
- o Relation to indoor living space;
- o Climatic conditions, orientation, and sun exposure;
- o Privacy control such as location, grade separation, enclosures, other visual screening using building and planting materials, and external noise control; and
- o Building and paving materials and landscaping.

Common open space may serve more functions than private open space. In addition to outdoor living and recreation, common open space provides for on-site pedestrian circulation and socialization between residents, and gives an identity to the group of housing units it serves. The following design aspects should be considered:

- o Size and dimension;
- o Definition of the area intended for common use;
- o Accessibility from the housing units served;
- o Relation to private open space such as patios, porches, and balconies;
- o Relation to public open space and pedestrian access, and parking areas associated with the housing units it serves;
- o Climatic conditions, orientation, and sun exposure; and
- o Building and paving materials, lighting, furniture, and landscaping.

Security

Security is an important concern in all urban residential neighborhoods. Housing design can influence the degree of protection from property crime, and the level of personal safety--both real and perceived--afforded residents. Housing designed with security considerations presents a strong deterrent to crime as well as psychological benefits for residents. The security aspects of housing design and cluster planning should be included in current Navy housing standards.

The issues of site access control and of technical aspects of door and window design and hardware are not discussed in this study, since the former issue should be dealt with as part of NAS Alameda Station-wide security, and the latter is beyond the scope of this study. The following discussion focuses on the guiding principles of open space planning and design, and building siting in a manner having a deterrent effect on crime. The approach should include the following basic considerations:

- o Avoid unassigned common open space that does not lend itself to surveillance by the public and residents.
- o Achieve a sense of territoriality by organizing space in a clear territorial order, from public to semi-private to private space, using a variety of treatments such as physical layout, paving, grade separation, landscaping, and barriers created by artificial or planting materials; by defining and controlling major entrances from one space to another; and by dividing spaces outside housing units or groups of housing units to provide a clear perception of the right to use such spaces.
- o Promote social interaction by organizing social groups through the physical arrangement of housing units in clusters, thus providing social support to residents and reinforcing the sense of territoriality.
- o Facilitate surveillance through a combination of physical design and lighting, such as entrance courts, pedestrian walkways, and unit entrances.

Neighborhood Compatibility

The Annex site differs considerably from neighboring housing sites. Therefore, Navy standards on neighborhood compatibility should be tailored to suit local conditions. While the two neighboring developments do not seem to have a distinct character that warrants preserving, it is advisable for the new development to borrow from them the basic forms of the existing buildings and the materials and colors used, and to improve upon them, creating an overall compatibility among the three sites. Design elements commonly found in existing housing on the neighboring sites include:

- o Roofs with gentle slopes;
- o Wood and stucco finishes on external walls;
- o Housing units with balconies and enclosed private patios; and
- o Housing units arranged in clusters.

Other important measures to improve design emphasize the following approaches:

- o Minimize the institutionalized character of the housing design;
- o Manifest a human scale in the building facade and in space planning, both indoor and outdoor;
- o Introduce landscaping as a means of humanizing the environment and providing a reference to scale; and
- o Create more variety in the visual quality of the buildings, although the same housing types may be repeated.

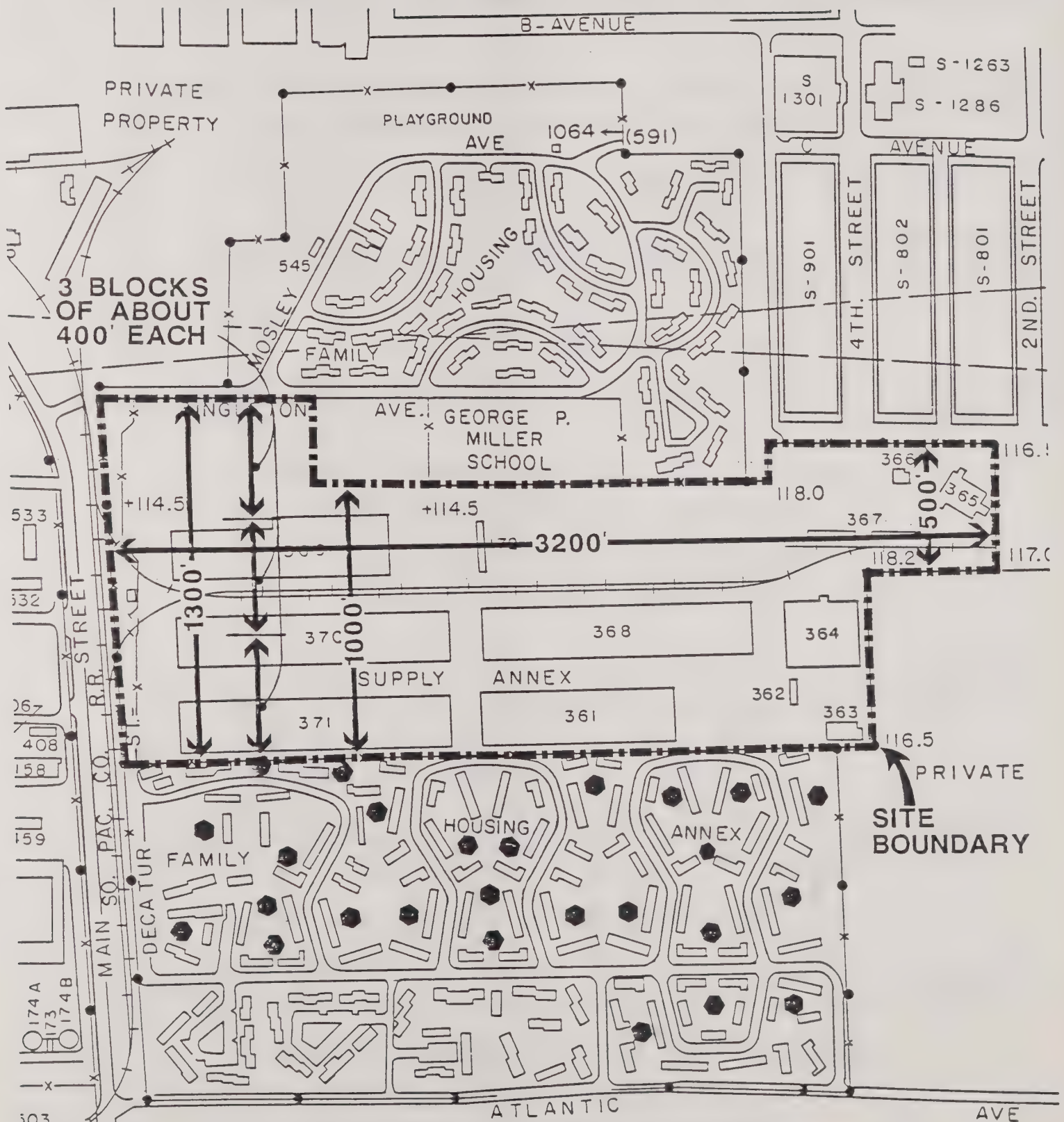
IV. HOUSING PROTOTYPE DESIGN AND ANALYSIS

This chapter focuses on the design and analysis of two alternative housing types to demonstrate how the housing units can be organized into clusters, which will become the basic building block for master-planning the Annex site for future development. Therefore, it is important to make reasonable assumptions on the organization of the entire site before embarking on unit design and housing unit cluster planning.

Site Organization

As shown in Figure 1, the Annex site is approximately 3,200 feet long in the east-west direction, with the width varying from 1,300 feet to 1,000 feet, and 5,000 feet near the eastern end. If the site is divided along its width into three blocks, each would be about 400 feet deep, an acceptable dimension for development. It is assumed each block will consist of two rows of back-to-back housing clusters, about 200 feet deep, each row served by a local collector roadway on one side and a major pedestrian walkway on the opposite side running along the centerline of the block, as shown in Figure 2. After defining the depth of the housing clusters, the length may vary according to the land area required to accommodate all the units in a cluster and land for associated parking and open space. Due to the variations in the width of the Annex site, half-blocks will be formed in the narrower portion. The depth of the housing cluster also will vary perceptibly as will the site design in the housing clusters, creating a more interesting and varied Master Plan for housing development.

Figure 1
ALAMEDA ANNEX SITE

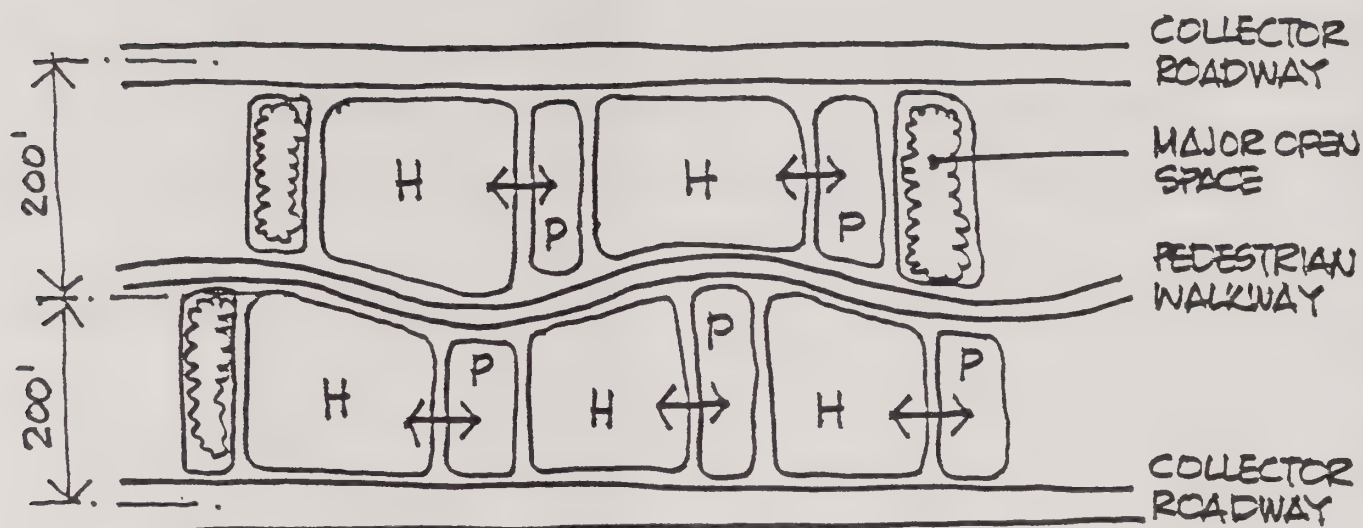


SITE AREA: 74 ACRES

FEET 0 500 1000

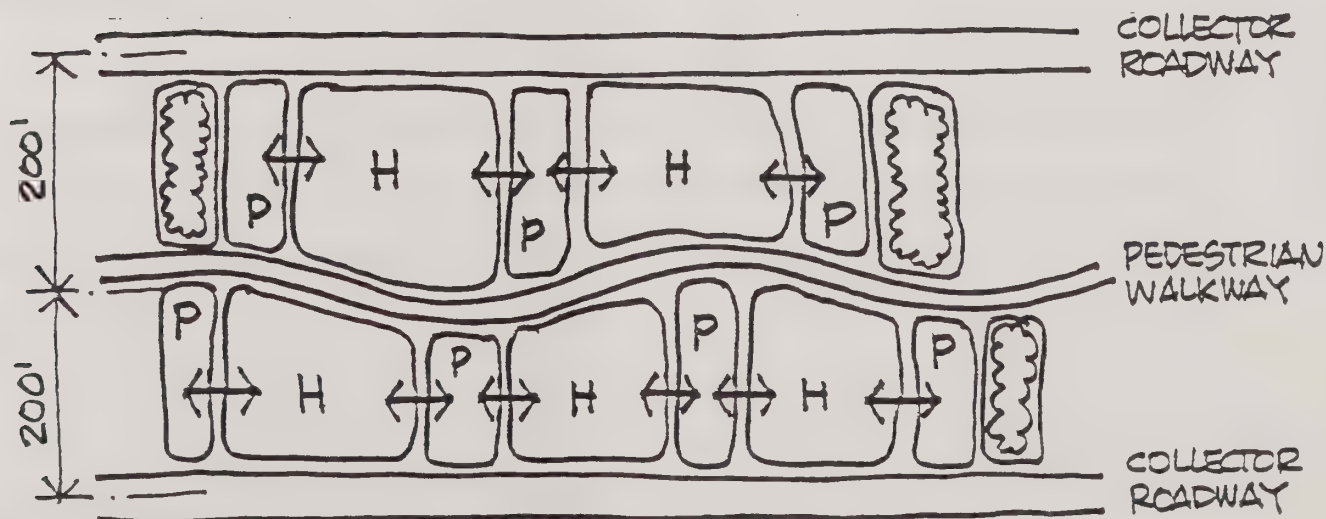


ALTERNATIVE HOUSING/PARKING RELATIONSHIPS



PARKING AREA SERVING ONE CLUSTER

- REINFORCES SOCIAL NETWORK
- INCREASES WALKING DISTANCES
(MAXIMUM OF APPROXIMATELY 200 FEET)



PARKING AREA SERVING TWO CLUSTERS

- WEAKENS CLUSTER IDENTITY
- REDUCES WALKING DISTANCES
(MAXIMUM OF APPROXIMATELY 100 FEET)

Housing Types

In developing housing prototypes, the standards specified in NAVFAC 12-83-2553 are generally used as guidelines; these standards include yard requirements, distance controls on opposing walls, interior spatial planning, and major open space on-site.

The two housing types studied are:

- o Duplex; and
- o Quadruplex (fourplex).

The duplex is the only housing type allowed in the City of Alameda other than single family residences; the duplex consists of two housing units per structure. Compared to other multi-family housing types, duplexes usually provide better privacy and are more liveable.

The quadruplex consists of four housing units per structure. This type of housing was selected for the study as an alternative to the duplex, to increase units per structure without dramatically changing building type or the living environment of the housing area.

Duplex Housing

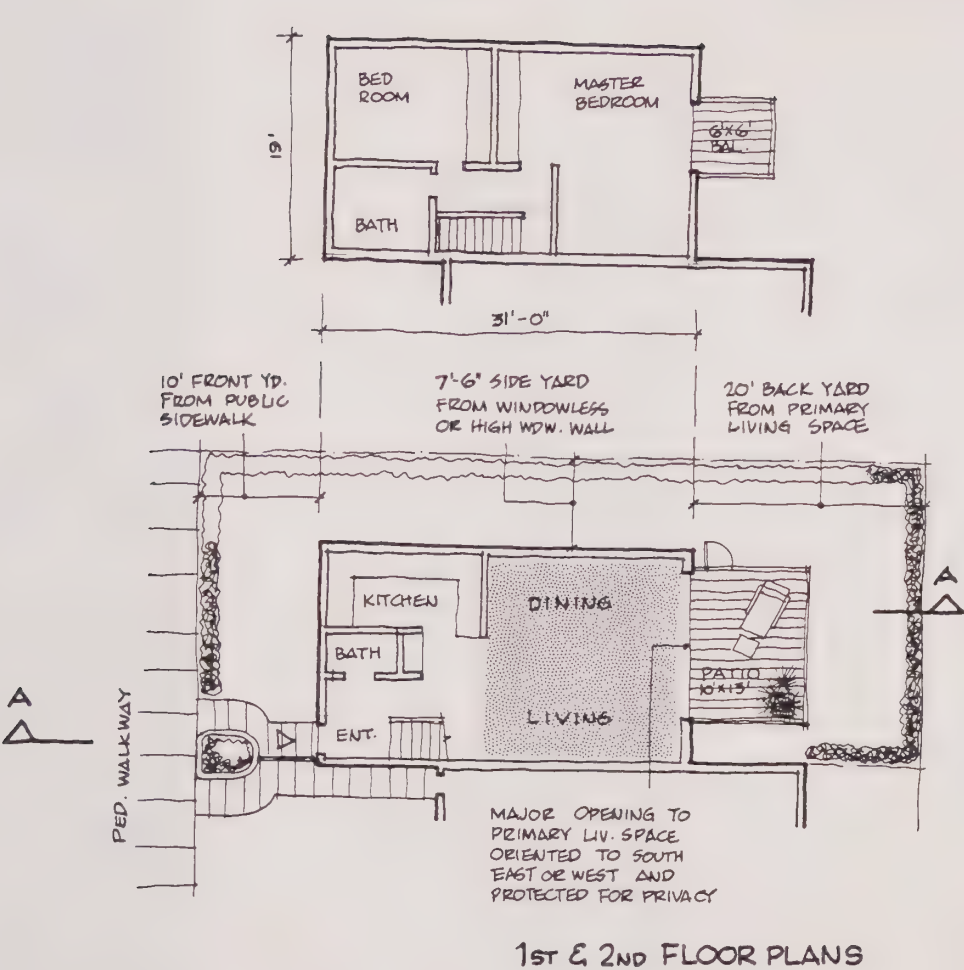
By definition, a duplex consists of only two housing units in a structure. The town-house design was chosen over an apartment-flat design due to its many advantages, such as individual entrances, more equitable access to open space on-grade, and more

privacy. The duplex prototype design and cluster plan are illustrated in Figures 3 and 4.

Unit Design

- Floor Area:** The unit design follows the general guidelines of NAVFAC Specification No. 12-83-2553. The unit prototype has two bedrooms and a gross floor area of 1,178 square feet, including structures, stairs, bulk storage, and other service space (i.e., 124% of 950 square feet, the maximum net floor area, as required by the Navy), but excluding balcony and patio space.
- Floor Plan:** Because of the cluster layout, not every housing unit can have a favorable orientation, such as to the south. Therefore, two floor plans of identical floor areas are developed with main orientations in the opposite directions, to overcome this inflexibility (see Figure 3, Unit Types A and B).
- Space Priority:** The unit design is based on a clear distinction of primary living space (including living, dining, family rooms), secondary living space (including bedroom, work area), and service areas (such as bathroom, corridor, hallway, storage area). This approach sets a priority in interior space planning, giving primary living space the most favorable location and orientation due to the amount of activity it experiences during the day.

Figure 3
DUPLEX UNIT PLAN



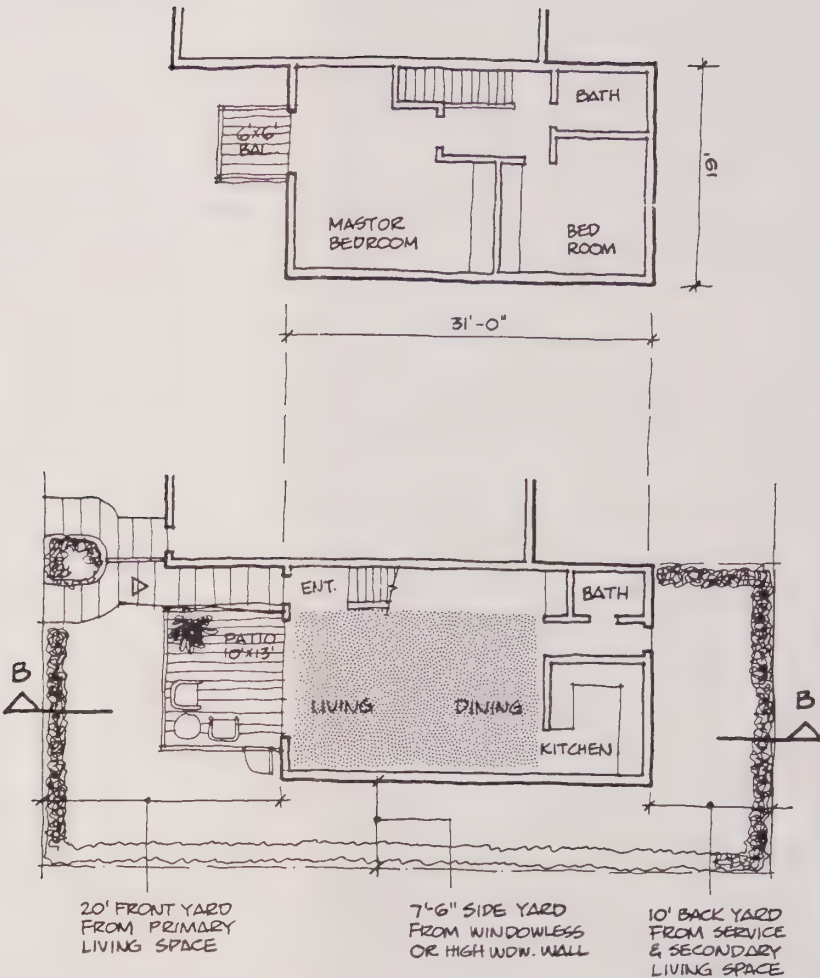
1st & 2nd FLOOR PLANS



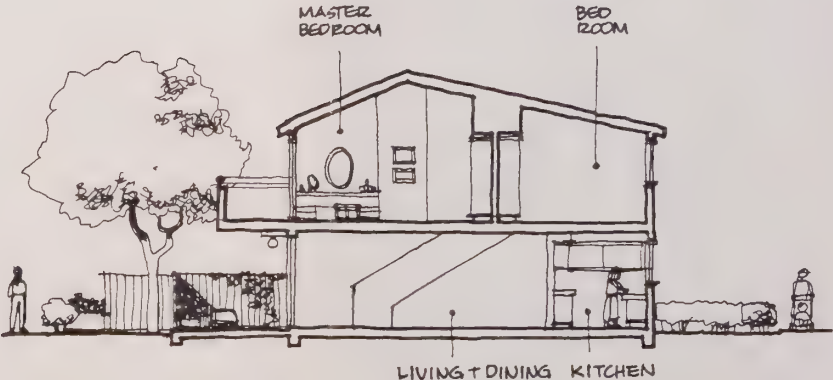
SECTION A-A

A 2-BEDROOM DUPLEX

GROSS FLOOR AREA: 1,178 S.F.
(INCLUDING STRUCTURE, STAIR
STORAGE BUT EXCLUDING PATIO
AND BALCONY)



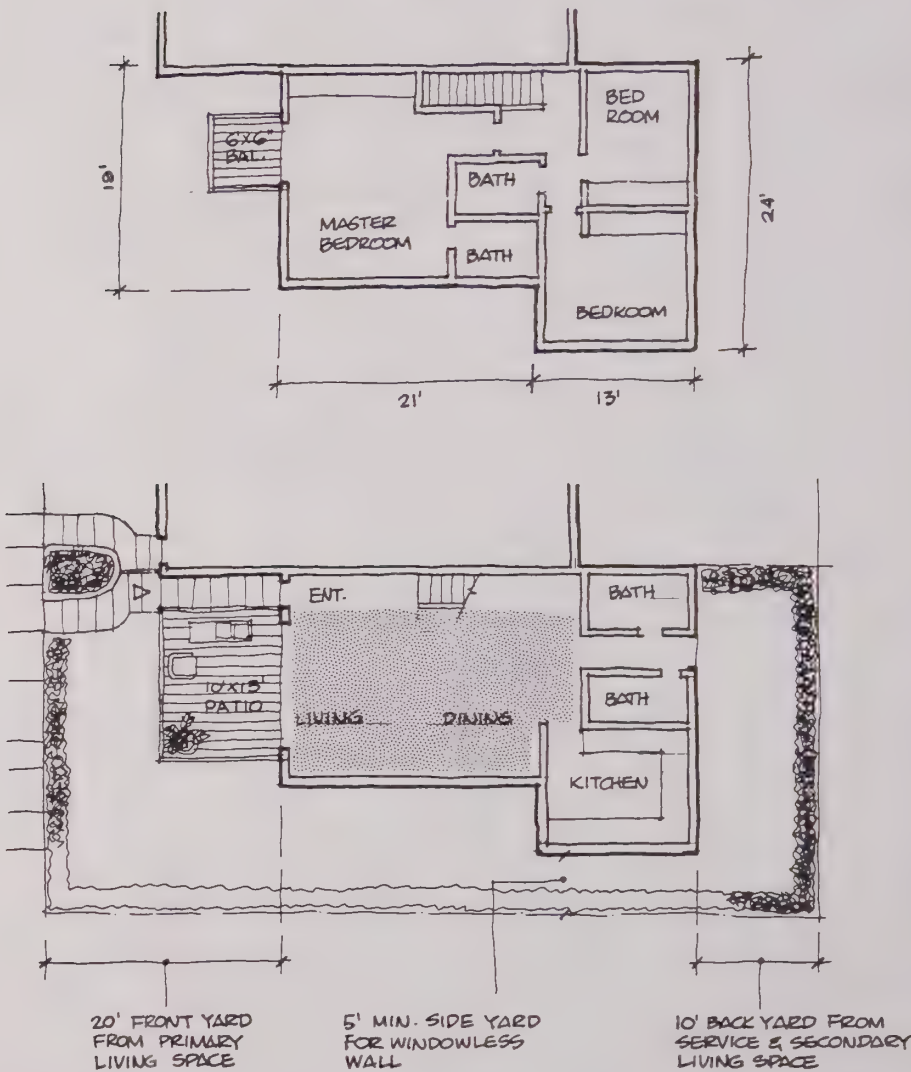
1st & 2nd FLOOR PLANS



SECTION B-B

B 2-BEDROOM DUPLEX

REVERSED PLAN TO TYPE A
WITH SAME GROSS FLOOR AREA.



1st & 2nd FLOOR PLANS

C 3-BEDROOM DUPLEX

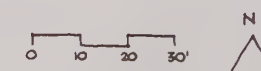
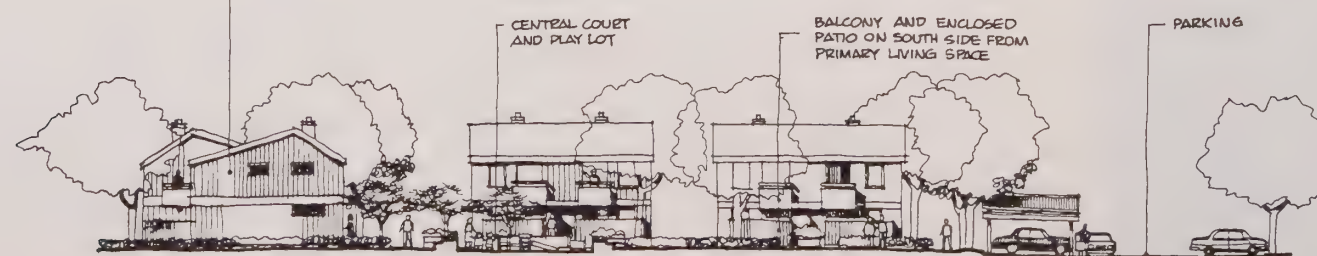
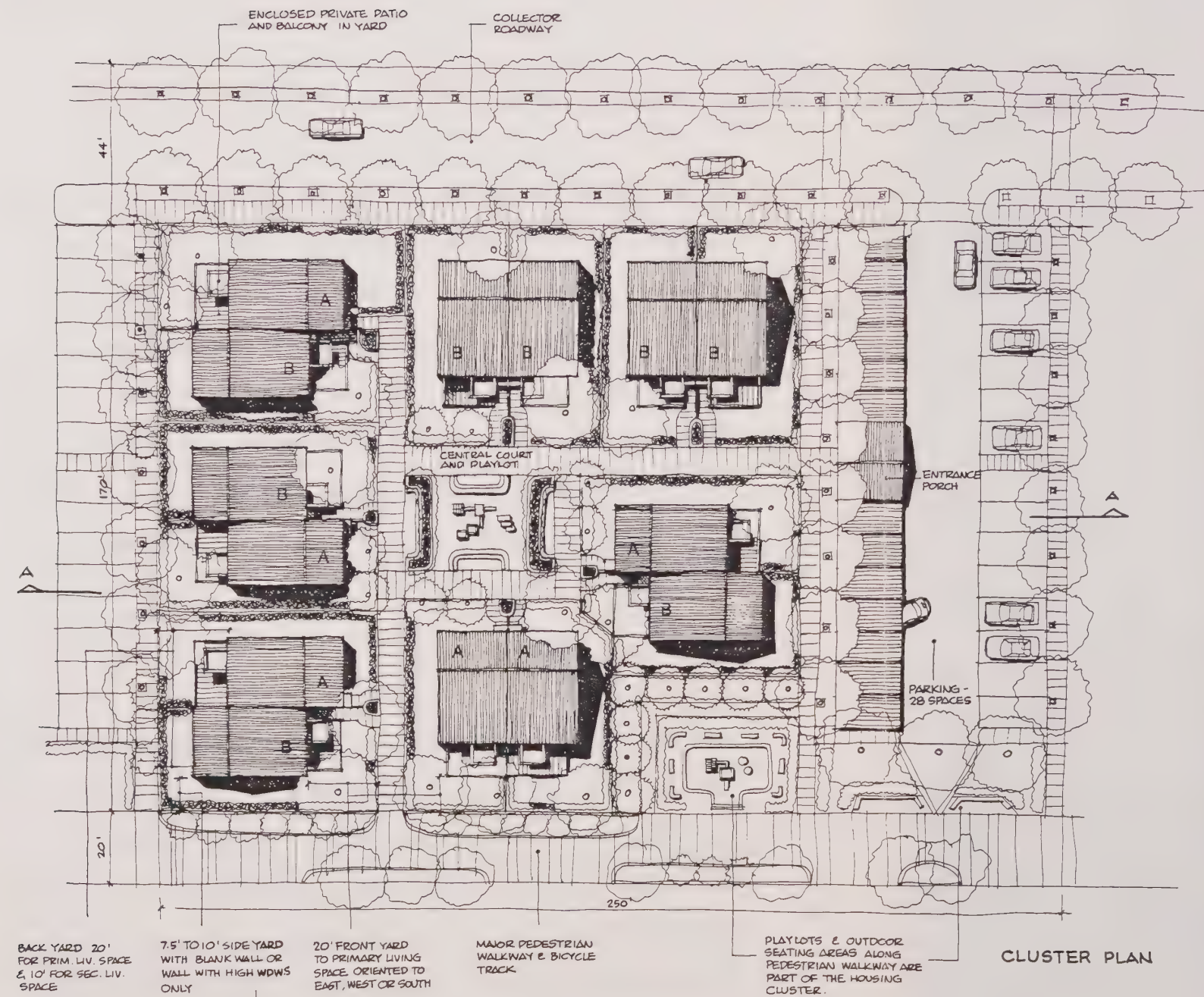
GROSS FLOOR AREA: 1,422 S.F.
(INCLUDING STRUCTURE, STAIR
STORAGE BUT EXCLUDING PATIO
AND BALCONY)

PRIMARY LIVING SPACE

0 5 10 15'

Western Division-Naval Facilities Engineering Command
Annex Site Housing Study
Naval Air Station Alameda

DUPLEX CLUSTER PLAN



Western Division - Naval Facilities Engineering Command
Annex Site Housing Study
Naval Air Station Alameda

Unit Layout: For access and privacy, the unit is designed with the living and dining areas, kitchen, and half-bath on the first floor, and more private bedroom space on the second floor with a full bath.

Cluster Plan

Cluster Size: Each cluster of duplexes consists of 14 housing units in seven separate buildings, occupying an area of about 250 by 170 feet, i.e., 42,500 square feet or 0.97 acre. As shown in Figure 4, this area would include all the land required for housing, associated parking, pedestrian circulation, open space such as entrance courts, yard areas, and play lots; it would not include area-wide recreational open space for basketball or handball courts, rights-of-way for collector roadways, or major pedestrian walkways and bicycle paths.

Housing/Parking

Relationship: For the efficient use of land and better separation of pedestrian from vehicular traffic, the housing and parking areas are not mixed, but are adjacent to each other, resulting in a more efficient parking and housing cluster plan. About one-half of all parking spaces are provided with carports with a porch connecting to the entrance court of the cluster. The walking distance from the entrance to the parking area would be about 50-200 feet through landscaped open space; the greater walking distance would be needed only if the parking area were to serve a single cluster (see Figure 2).

Housing Units: Within a cluster, duplex units are arranged surrounding a central court from which all housing units are accessible independently. Primary living space is oriented towards desirable views in the south, east, or west directions only. A 20-foot yard is provided in front of major openings to primary living space, whereas only a 10-foot yard is recommended for windows from secondary living space; an even smaller yard is recommended in case of windowless walls or walls with high windows (see Table I in Chapter II). Design variations in unit types (Type A or Type B) and associated facade treatment are balanced with appropriate control of basic roof forms, materials, and colors, to produce a unified character in the cluster and a desirable and interesting living environment.

Open Space: Open space within each cluster is divided up into various areas and arranged in a territorial order of public space, semi-private space, and private space. The central entrance court and its associated walkways, seating areas, and play lots will be shared by all residents of the same cluster. The yard space associated with the units is defined by landscaping and intended for use as additional play area for outdoor activity by residents and visitors. Visually screened patios become extensions to indoor living space and are treated as private open space.

Three-Bedroom

Unit: The housing program consists of about 12% 3-bedroom units, with the balance 2-bedroom units. Therefore, in a typical cluster

consisting of 14 units, 1-2 units would have 3 bedrooms, as shown in Figure 3, Unit Type C. The interior spatial arrangement of a 3-bedroom unit is similar to its 2-bedroom counterpart. Externally, its relationship to the building, to the other housing unit attached to it, and to the other elements in the housing cluster remain interchangeable with that of a 2-bedroom unit, thus allowing maximum flexibility in distribution of units of different sizes.

Quadruplex Housing

A quadruplex consists of four housing units in a building. The building mass and external design are similar to a duplex, with two apartment flats on each side of a central entrance and stairway. The advantages of this housing type are mainly found in the relative economy in the use of land and lower construction cost, compared to duplex housing.

Unit Design

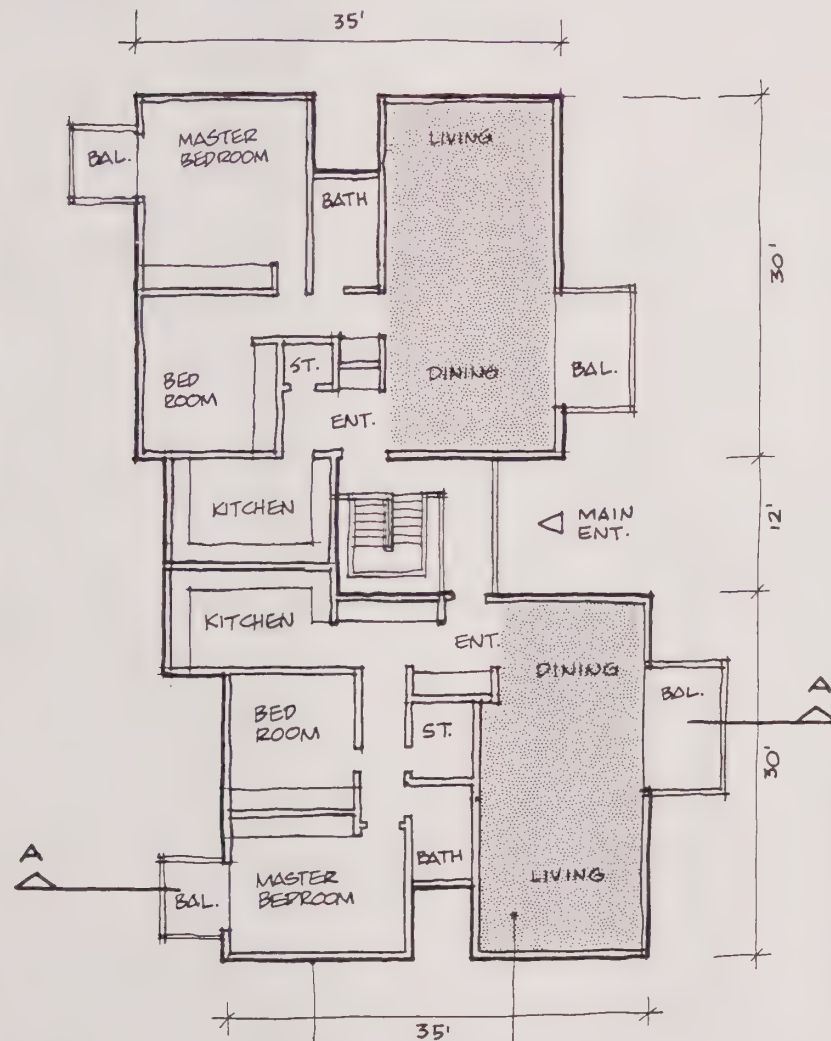
Floor Area: The 2-bedroom unit prototype has a gross floor area ranging from 1,130 to 1,170 square feet, including structure, bulk storage, and other service areas (i.e., 119-123% of 950 square feet, the maximum net floor area, as required by the Navy), but excluding external stair, access balcony, and all private open space such as balconies and patios.

- Floor Plan:** As with the duplex unit, two floor plans are developed with opposite orientations to overcome the orientation limitation of a cluster. They are unit Types D and E in Figure 5.
- Space Priority:** The principle of prioritizing living space in three grades--primary living space, secondary living space, and service area--within a unit also applies to this housing type.
- Unit Layout:** In an apartment flat, the entire housing unit is on one level. The living space is therefore arranged horizontally, with the living and dining rooms on one side of the building with views and more desirable orientation, and the bedrooms facing the other side. Bathrooms, hallways, and storage spaces are used to protect the living space from external noise and visual intrusion, located mainly against windowless walls or walls with high windows.

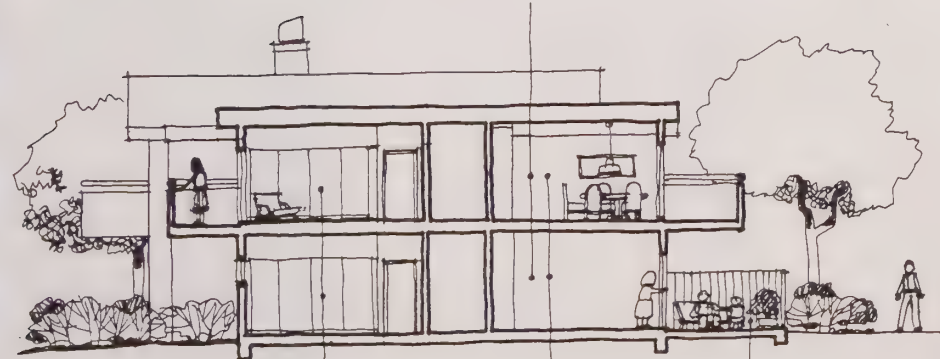
Cluster Plan

- Cluster Size:** A cluster of quadruplexes consists of 16 housing units in four separate structures, occupying a land area of about 170 by 240 feet, i.e., 40,800 square feet or 0.93 acre. This area would include all the land required for units, associated parking, pedestrian circulation, and open space, as in the case of a duplex cluster. A typical cluster is shown in Figure 6.

2ND FLOOR PLAN
(1ST FLOOR PLAN SIMILAR)



SIDE WALLS WITH HIGH WDW.S' ONLY
PRIMARY LIVING SPACE WITH BALCONY OR EN-CLOSED PATIO ORIENTED TO SOUTH, EAST OR WEST



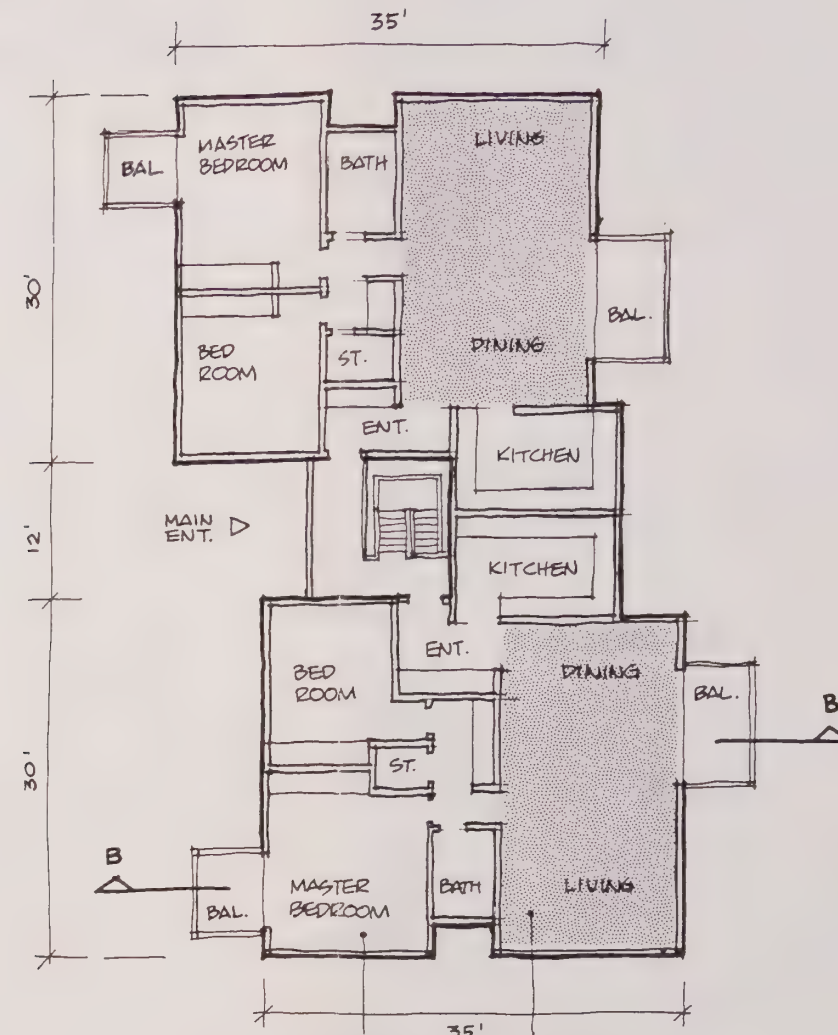
MASTER BEDROOMS
DINING AND LIVING ROOMS
ENCLOSED PATIO

SECTION A-A

D 2-BEDROOM QUADRUPLEX

GROSS AREA: 1,130 - 1,170 S.F.
(INCLUDING STRUCTURE, STORAGE BUT EXCLUDING STAIR, PATIO & BALCONY)

2ND FLOOR PLAN
(1ST FLOOR PLAN SIMILAR)



REVERSED PLAN SHOWING
PRIMARY LIVING SPACE ON THE
OPPOSITE SIDE OF MAIN ENTRANCE



MASTER BEDROOMS
DINING AND LIVING ROOMS
ENCLOSED PATIO

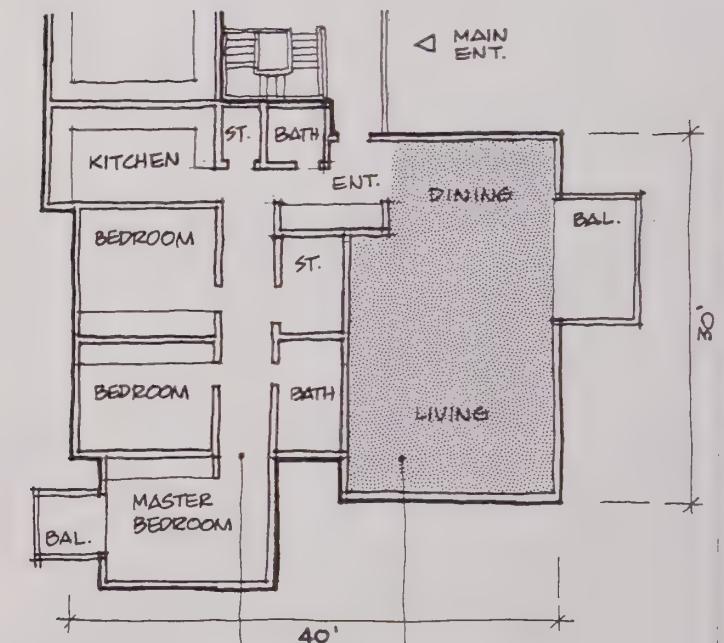
SECTION B-B

E 2-BEDROOM QUADRUPLEX

GROSS AREA: 1,130 - 1,170 S.F.
(INCLUDING STRUCTURE, STORAGE BUT EXCLUDING STAIR, BALCONY & PATIO)

Figure 5
QUADRUPLEX UNIT PLAN

2ND FLOOR PLAN
(1ST FLOOR PLAN SIMILAR)



INTERIOR SPACE ARRANGEMENT
IN A 3-BEDROOM UNIT SIMILAR
TO A 2-BEDROOM UNIT

F 3-BEDROOM QUADRUPLEX

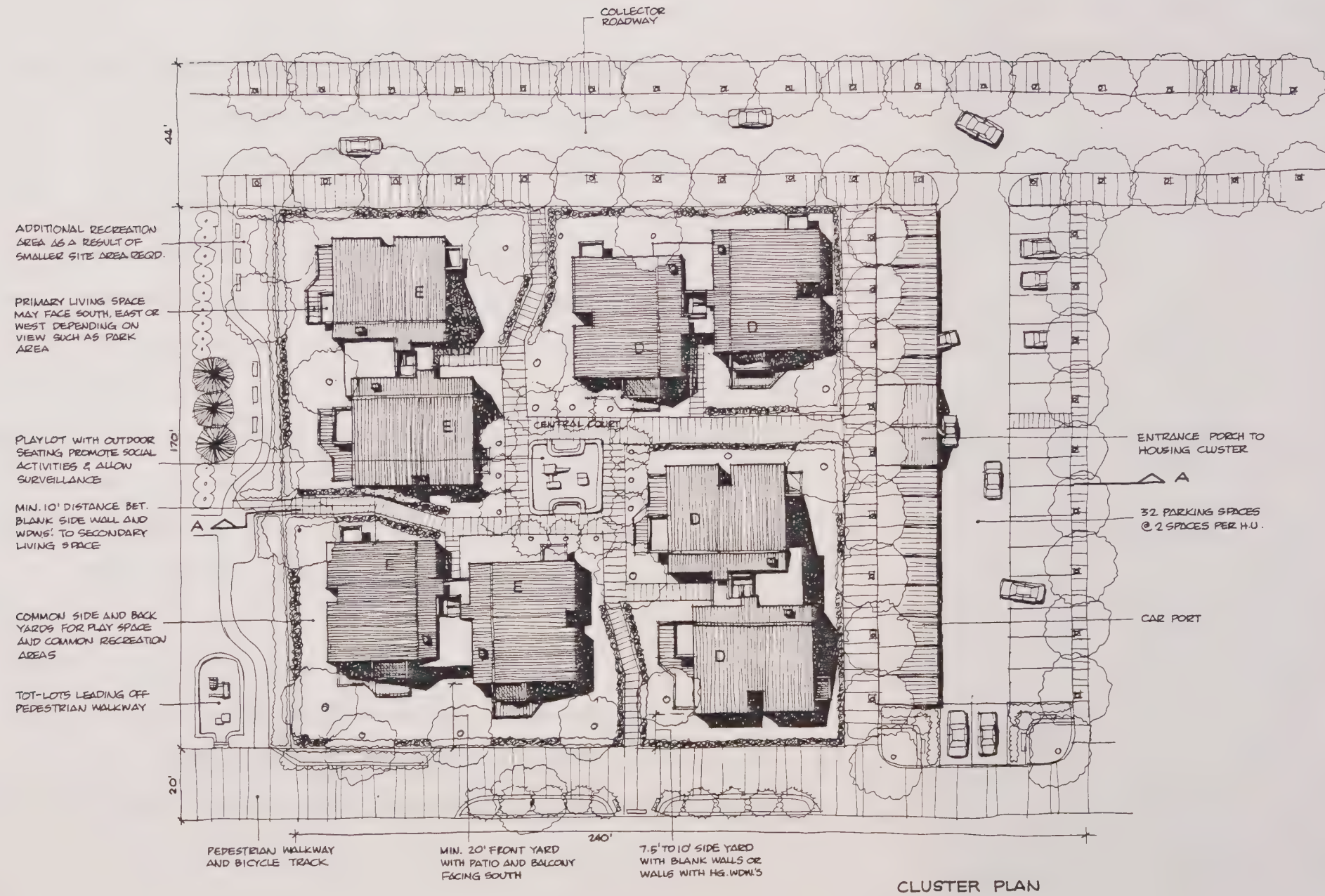
GROSS AREA: 1,400 S.F.
(INCLUDING STRUCTURE, STORAGE BUT EXCLUDING STAIR, BALCONY & PATIO)

PRIMARY LIVING AREA

0 5 10 15'

Western Division-Naval Facilities Engineering Command
Annex Site Housing Study
Naval Air Station Alameda

QUADRUPLEX CLUSTER PLAN



Western Division Naval Facilities Engineering Command
Annex Site Housing Study
Naval Air Station Alameda

Housing/Parking

Relationship: Housing and parking areas are adjacent to each other, similar to duplex housing.

Housing Units: In a similar manner as duplexes, housing units are planned around a central entrance court, from which the individual units are entered. In the east-west orientation, the units can be planned with the primary living space facing either side, depending on the view. However, in the north-south orientation, only units with a southern orientation to primary living space are used. Yard space requirements in a quadruplex are the same as in a duplex.

Open Space: While the first-floor unit will be provided with an enclosed patio, as in a duplex, the second-floor unit will have access to a balcony from the primary living space. The hierarchy of open space on-site will be similar to the arrangement of a duplex cluster.

Three-Bedroom

Unit: As in the duplex design, a 3-bedroom unit is designed to be interchangeable with any 2-bedroom units. However, since there are two units on each side of the building, they should be treated as one entity in the design, as shown in Unit Type F on Figure 5.

Land Requirement Comparison

The two housing types have different demands for land. A duplex cluster consisting of 14 housing units would occupy an area of 0.97 acre, whereas a quadruplex cluster consisting of 16 housing units would need 0.93 acre of land. The housing program, including housing units, parking, and major recreation and circulation elements on-site, would have sufficient land for quadruplex housing but not for duplex housing. Table 3 summarizes the land allocation calculation for the two housing prototypes.

The duplex would need 66.5 acres of land for the 960 units with parking and play lots. The quadruplex would need only 55.8 acres of land to satisfy the same housing program, i.e., 84% of the land required by duplex-type housing.

Cost Comparisons

As in the requirement for land, the cost of construction differs for the two housing types, although floor areas, type of building construction, and the materials proposed are similar. This is mainly due to differences in site area, floor plan configuration, and the building envelope. As a result, there are notable variations between the two housing types with respect to the following items (see Appendix A for details): site area; building volume; roof area; external wall area; internal partitions; and plumbing fixtures.

Table 3

Land Allocation Calculation

	<u>Acreage</u>	<u>Percentage of Site Area</u>
Total Site Area	74.0 acres	
Major space for active recreation (20,000 square feet per 120 units)	3.6 acres	4.9
Roadways (7,000 feet)	7.1 acres	9.6
Pedestrian/bicycle paths (9,000 feet)	4.1 acres	5.5
Housing area with parking, play lots	59.2 acres	<u>80.0</u>
		100.0%

Duplex Housing:

Land area required per cluster (including housing, parking, play lots): 0.97 acre

Number of clusters possible: 61

Number of units possible: 854

Number of units short of the programmed 960 units: (106)

Quadruplex Housing:

Land area required per cluster: 0.93 acre

Number of clusters possible: 63.6

Number of units possible: 1,018

Number of units in excess of the programmed 960 units: 58

Cost estimates are based on total construction cost of a cluster, including units and balconies, patios, and yards; associated parking areas; and common open space such as the entrance court, walkways, and play lots. The combined cost then is distributed to a per-unit basis for comparison's sake. For the purpose of this analysis, all units in the cluster are assumed to be 2-bedroom. Cost comparisons between 3-bedroom units are expected to be the same order-of-magnitude as 2-bedroom units. Table 4 summarizes major cost distributions of the two types.

Based on these cost estimates, a housing unit in a quadruplex cluster costs approximately 5% less than a housing unit of similar size in a duplex cluster.

Table 4

Construction Cost Summary

	One Duplex Cluster with <u>14 Units</u>	One Quadruplex Cluster with <u>16 Units</u>
Total building construction	\$ 852,350	\$ 955,160
Total site construction (including landscaping, on-site utilities)	233,080	225,967
Contractors expense, fees, overhead, profits	145,448	158,271
Construction cost (November 1987)	1,230,888	1,339,398
Contingency and inflation (15%)	191,112	207,602
Construction budget (March 1988)	1,422,000	1,547,000
Cost per unit	101,571	96,687

V. CONCLUSIONS

The results of the analysis as presented in the previous chapters are summarized as follows:

1. The Annex site does not have a sufficient acreage of land to accommodate the full program of 960 housing units, and ancillary uses, in the form of duplex housing. The shortfall is about 100 housing units.
2. Duplex housing results in a gross density of 11.5 housing units per acre, and the quadruplex results in 13.7 housing units per acre. Both housing types are substantially higher than the Station's existing 7 or fewer housing units per acre, and a substantially lower density than commonly adopted by the Navy in its personnel housing development. Further, it can be demonstrated that at such higher densities, the standards of housing will not be compromised if qualitative standards as well as quantitative ones are applied to housing development. The quality of the living environment can best be safeguarded through sensitive design and planning based on application of appropriate design guidelines or standards.
3. The land requirement for duplex housing construction is greater than for multi-family housing. Quadruplex housing, for example, only requires 84% of the land required by duplexes. Therefore, a combination of duplexes and other forms of multi-family housing should be considered.

4. The cost of construction is only slightly higher for duplex housing than for quadruplex housing. The cost of a housing unit in a quadruplex cluster is 5% less than a similar unit in a duplex cluster--not a significant difference. However, more savings may be possible using larger structures with more housing units.

The above findings indicate that duplex housing has merits as well as limitations compared to multi-family housing. On the upside, the extra cost for development of this housing type is very reasonable considering the more desirable overall living conditions, both indoor and outdoor. Furthermore, this housing type is certainly acceptable by the City of Alameda, which will provide many public services to future residents of this housing development. However, this study also indicates that the Annex site may have insufficient land to accommodate the full housing program in a duplex style, with all the ancillary facilities. It is clear that refinement to the housing program is necessary to achieve the dual goals of fulfillment of the housing program and compatibility with the City of Alameda's current housing development policy. There are several approaches worth considering:

1. Locate major active recreation spaces such as ball courts on an off-site location accessible from the housing areas. The open area north of the existing housing and the Annex site is a potential site for relocation of major active recreation spaces. This would add 3.6 acres of land for housing development, accommodate an additional 52 units, and reduce the shortfall to 48 units, or 5% of the housing program.
2. Reduce common recreational space such as play lots because of the considerable amount of readily accessible semi-private and private open space

around the housing units for playing and other recreation purposes (see the housing prototype designs). A reduction of 50% in play lots will add 1.1 acres of land for housing development, sufficient for 16 additional units of duplex housing. In combination with the above measure, the shortfall will be further reduced to 32 units, or 3% of the housing program.

3. Combine duplex housing and other forms of multi-family housing as an alternative solution. The multi-family housing unit would be designed as several connected parts, thus visually reducing it to a scale comparable to a duplex unit. Additional mitigation measures such as landscaping may be introduced to further improve the quality of the living environment.
4. Revise current Navy standards specified in NAVFAC Specification No. 12-83-2553 as recommended in Chapter II, to allow higher density housing development on the Annex site. Current standards are intended for 5.8 housing units per acre, whereas the projected density on this site is 12.9 housing units per acre. Among all the provisions, the standards regarding the parking/housing relationship, compact car spaces, yard dimensions, and distances between opposing walls most directly affect density.
5. Strengthen current Navy housing standards to improve quality of development. Design standards for interior space planning, relationship between indoor and outdoor living, local open space, and landscaping design should be improved.

APPENDIX A: COST ESTIMATE ON HOUSING PROTOTYPES

C O S T P L A N

for

Housing Alameda NAS
Alameda NAS

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Urban Planners and Design
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November 13, 1987

ADAMSON Associates

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C O N T E N T S	Page Nos.
References	1
Inclusions and Exclusions	1
Areas	2
Control Quantities	2
Component Summary	3
Component Budgets	4 - 16

Cost Plan prepared from:

	Dated	Received
Drawings 4 sheets	Undated	11/06/87
Specifications 2 pages	Undated	11/06/87
Discussions with Alex Lui		

Cost Plan includes:

Comparison of construction cost for two different housing layouts. Cost of Option I is for 16 units in quadruplexes, with two bedrooms and one bathroom, Option II is for 14 units in duplexes with two bedrooms and 1½ bathrooms.

Buildings of light wood framed structures, with reinforced concrete strip or isolated footings, ground floor will be poured in place concrete slab on grade.

Exterior wall finished with stained redwood siding, stucco at balcony, and band at 2nd floorline.

Interior walls finished with textured gypsum board over wood stud framing, with ceramic tile in full bathrooms. Walls are a three coat paint system.

Thermal insulation at perimeter walls, roof and floor. Sound insulation occurs between party walls and bathroom walls.

Pitched roof with composition shingles, flatroofs at Option I will be built-up tar and gravel.

Second floor deck coated with elastomeric traffic topping deck system (Dexotex), first floor patios will be finished concrete slab.

Plumbing with 1 bath in 2 bedroom units in quadruplexes and 1½ bath in 2 bedroom units in duplexes.

Appliances include refrigerator, oven, hood, microwave, garbage disposal, dishwasher, and washer/dryer hookup.

Landscaping, parking, curbs, paving, carport, tot playground, lighting, benches in housing sites and parking lot areas only.

Assumes normal soil conditions.

Cost Plan excludes:

Site preparation.

Fire protection. (sprinklers)

Professional design, testing, inspection, and management fees.

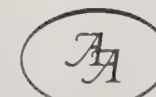
Legal and financing costs.

Premium time cost for work performed outside regular trade work hours.

Building permit and fees.

	<u>OPTION I</u>			<u>OPTION II</u>		
	SF Per Building	SF Total 8 Buildings	SF	SF Per Building	SF Total 7 Buildings	SF
<u>AREAS</u>						
Enclosed						
First Floor	1,110	8,880		1,178	8,246	
Second Floor	1,103	8,824	17,704	1,178	8,246	16,492
Covered Exterior at ½ value	(½)150	600	600	(½)72	252	252
Total	2,288		18,304	2,392		16,744

	<u>OPTION I</u>		<u>OPTION II</u>	
	Total 8 Buildings	Ratio	Total 7 Buildings	Ratio
Gross Area	18,304	1.000	16,744	1.000
Volume	206,920	11.305	181,412	10.834
Exterior Wall Area	23,872	1.304	22,456	1.341
Window Area	2,992	0.164	2,618	0.156
Roof Area	8,880	0.485	9,044	0.540
Interior Partitions	14,400	0.787	11,655	0.696
Finished Area	17,752	0.970	16,492	0.985
Plumbing Fixtures (x 1,000)	80	4.371	84	5.017
Site Area	40,370	2.203	42,672	2.549
Finished Site Area	40,320	2.203	42,672	2.549



Component Summary	OPTION I		OPTION II		
	\$/SF	\$	\$/SF	\$	
1. Foundations	1.42	26,062	1.66	27,720	
2. Vertical Structural Members	3.26	59,680	3.35	56,140	
3. Floors and Roofs	5.93	108,456	5.54	92,768	
4. Exterior Cladding	11.86	217,058	11.49	192,440	
5. Roofing and Waterproofing	2.27	41,480	2.35	39,288	
6. Interior Partitions	6.77	123,944	5.98	100,122	
7. Floor, Wall and Ceiling Finishes	5.95	108,872	5.55	92,932	
8. Function Equipment and Specialties	7.57	138,568	7.21	120,750	
9. Vertical Transportation	0.71	13,040	0.96	16,100	
10. Plumbing	2.51	46,000	3.05	51,100	
11. HVAC	1.75	32,000	1.67	28,000	
12. Electrical	2.19	40,000	2.09	35,000	
TOTAL BUILDING CONSTRUCTION	52.19	955,160	50.90	852,360	
14. Site Preparation		-0-		-0-	
15. Site Development	9.28	169,967	10.99	184,080	
16. Utilities	3.06	56,000	2.93	49,000	
TOTAL SITE CONSTRUCTION	64.53	1,181,127	64.82	1,085,440	
General Contractor's site establishment, supervision, equipment, temporary services, job expense and performance bonds	8 %	5.16	94,490	5.19	86,835
General Contractor's Fee or Overhead & Profit	5 %	3.48	63,781	3.50	58,613
Planned Construction Cost November 1987	73.17	1,339,398	73.51	1,230,888	
Contingency for Design Development	10 %	133,942		123,112	
Allowance for Rising Costs to Mid-point of Construction	5 %	73,660		68,000	
Recommended Budget for Construction Commencing 2nd Quarter 1988		\$1,547,000		1,422,000	
Cost per Unit		\$96,687		\$101,571	

November 13, 1987

ADAMSON Associates

170 Columbus Avenue
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	QUANTITY	UNIT	RATE	\$
<u>1. Foundations</u>				
Wall footings at building perimeter and along kitchen wall	1,448	LF	18.00	\$26,062
<u>2. Vertical Structure</u>				
Exterior wall framing with sheathing	23,872	SF	2.50	\$59,680
<u>3. Floor and Roof Structure</u>				
Floors				
Slab on grade	8,880	SF	4.00	35,520
Second floor frame and sheath	8,880	SF	3.20	28,416
Second floor insulation R-19	8,880	SF	0.50	4,440
Ceiling and roof				
Second floor ceiling frame at master bedroom, bedroom, kitchen and baths	5,520	SF	2.25	12,420
Second floor balcony frame	816	SF	4.25	3,468
Pitch roof frame	8,064	SF	3.00	24,192
				\$108,456
<u>4. Exterior Cladding</u>				
Batt insulation in exterior wall	23,872	SF	0.40	9,549
Exterior finish				
Vertical siding	23,872	SF	2.20	52,518
Paint siding	23,872	SF	0.65	15,521
Stucco at second floor	2,320	SF	6.00	13,920
Stucco at balcony	3,936	SF	6.00	23,616
Paint stucco	6,256	SF	0.65	4,066
Wood trim				
Fascia at roof	1,208	LF	4.00	4,832
Trim at windows	1,600	LF	2.00	3,200
Paint wood trim	2,808	LF	1.00	2,808

<u>4. Exterior Cladding (continued)</u>	QUANTITY	UNIT	RATE	\$
Interior finish to exterior walls				
Gypsum board, taped and textured	23,872	SF	1.10	26,259
Paint gypsum board	23,872	SF	0.65	15,521
Windows and glazing	2,992	SF	12.00	35,904
Exterior doors, frames and hardware	16	EA	350.00	5,600
Paint exterior doors	16	EA	50.00	800
Exterior door trim	544	LF	2.00	1,088
Paint door trim	544	LF	1.00	544
Balcony rail cap	328	LF	4.00	1,312
				\$217,058

5. Roofing and Waterproofing

Waterproofing at slab	8,880	SF	0.50	4,440
Second floor balcony deck - dexotex	816	SF	6.00	4,896
Roofing insulation	8,880	SF	0.80	7,104
Roof				
Composition shingles	8,064	SF	1.50	12,096
Built-up tar and felt at kitchen area	812	SF	2.00	1,624
Sheetmetal				
Gutters	400	LF	5.00	2,000
Rainwater leader heads	12	EA	30.00	360
Downpipes	240	LF	4.00	960
Flashing		LS		4,000
Caulking and sealants		LS		4,000
				\$41,480

QUANTITY	UNIT	RATE	\$
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6. Interior Partitions

Wood framed partitions				
Wood studs 2" x 4" @ 16" O.C.	14,400	SF	1.50	21,600
Partition surfacing				
Gypsum board taped and textured	28,800	SF	1.10	31,680
Paint gypsum board	28,800	SF	0.65	18,720
Sound insulation at kitchen party wall and bathrooms				
	8,208	SF	0.50	4,104
Interior doors, frames, hardware				
3' x 6' hollow core	64	EA	250.00	16,000
Closet sliders	56	EA	350.00	19,600
Interior door trim	4,080	LF	2.00	8,160
Paint door trim	4,080	LF	1.00	4,080
				\$123,944

7. Floors, Walls, Ceiling Finishes

Floors				
Sheet vinyl at kitchen	1,792	SF	3.00	5,376
Tile at bath	960	SF	12.00	11,520
Carpet	15,008	SF	2.00	30,016
Bases				
Tile base	512	LF	4.00	2,048
Resilient base	3,848	LF	1.00	3,848
Walls				
Ceramic tile at bath	1,712	SF	12.00	20,544
Ceilings				
Gypsum board taped, and textured	17,760	SF	1.30	23,088
Paint gypsum board ceiling	17,760	SF	0.70	12,432
				\$108,872

	QUANTITY	UNIT	RATE	\$
<u>8. Equipment</u>				
Bath accessories				
Mirrors	336	SF	10.00	3,360
Medicine cabinets	16	EA	200.00	3,200
Toilet accessories	48	EA	30.00	1,440
Tub enclosure	16	EA	220.00	3,520
Closet shelf and pole	504	LF	7.00	3,528
Cabinets and countertops				
Kitchen cabinets				
Base	336	LF	130.00	43,680
Upper	336	LF	90.00	30,240
Plastic laminate countertop	336	LF	30.00	10,080
Bathroom vanities	16	EA	200.00	3,200
Home appliances				
Refrigerator	16	EA	700.00	11,200
Oven/cooktop	16	EA	600.00	9,600
Hood	16	EA	200.00	3,200
Microwave oven	16	EA	200.00	3,200
Garbage disposal	16	EA	120.00	1,920
Dishwasher	16	EA	450.00	7,200
				\$138,568

9. Exterior Stairs

Stairs				
Entry stairs - 1 flight	4	EA	1.6M	6,400
Handrails	240	LF	10.00	2,400
Landing and walkway to second floor entry	424	SF	10.00	4,240
				\$13,040

	QUANTITY	UNIT	RATE	\$
<u>10. Plumbing</u>				
Bathtubs with shower	16	EA	600.00	9,600
Waterclosets	16	EA	200.00	3,200
Lavatories	16	EA	175.00	2,800
Kitchen sink with dishwasher and disposal connection	16	EA	500.00	8,000
Rough-in washer/dryer	16	EA	300.00	4,800
Rough-in plumbing fixtures	64	EA	200.00	12,800
Water heaters	16	EA	300.00	4,800
				\$46,000

<u>11. Heating, Ventilating, and Air Conditioning</u>	16	EA	2.0M	\$32,000
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<u>12. Electrical</u>	16	EA	2.5M	\$40,000
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<u>14. Site Preparation</u>				-0-
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15. Site Development

Vehicular paving and curbs				
Asphalt paving - parking	9,888	SF	1.50	14,832
Concrete curbs	1,750	LF	8.00	14,000
Pedestrian paving				
Concrete walkways	5,020	SF	3.00	15,060
Site drainage		LS		5,000
Site lighting				
1 per 50' pedestrian walk	14	EA	1.0M	14,000

QUANTITY	UNIT	RATE	\$
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15. Site Development (continued)

Landscaping

Fine grading and soil preparation

40,320	SF	0.15	6,048
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Trees - large

31	EA	125.00	3,875
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Trees - medium

12	EA	80.00	960
----	----	-------	-----

Shrubs - 1 bush/6 lf

168	EA	20.00	3,360
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Fencing

Patio

336	LF	12.00	4,032
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Patio floor

1,760	SF	5.00	8,800
-------	----	------	-------

Tot playground

	LS		50,000
--	----	--	--------

Benches

10	EA	300.00	3,000
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Carport

2,700	SF	10.00	27,000
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\$169,967

16. Site Utilities

Site electrical, telephone, water - allow

\$56,000

	QUANTITY	UNIT	RATE	\$
<u>1. Foundations</u>				
Wall footings at building perimeter and along kitchen wall	1,540	LF	18.00	\$27,720
<u>2. Vertical Structure</u>				
Exterior wall framing with sheathing	22,456	SF	2.50	\$56,140
<u>3. Floor and Roof Structure</u>				
Floors				
Slab on grade	8,246	SF	4.00	32,984
Second floor frame and sheath	8,246	SF	3.20	26,387
Second floor insulation R-19	8,246	SF	0.50	4,123
Ceiling and roof				
Second floor balcony frame	504	SF	4.25	2,142
Pitch roof frame	9,044	SF	3.00	27,132
				\$92,768
<u>4. Exterior Cladding</u>				
Batt insulation in exterior wall	22,456	SF	0.40	8,982
Exterior finish =				
Vertical siding	22,456	SF	2.20	49,403
Paint siding	22,456	SF	0.65	14,596
Stucco at second floor	2,016	SF	6.00	12,096
Stucco at balcony	2,072	SF	6.00	12,432
Paint stucco	4,088	SF	0.65	2,657
Wood trim				
Fascia at roof	1,512	LF	4.00	6,048
Trim at windows	1,988	LF	2.00	3,976
Paint wood trim	3,500	LF	1.00	3,500

<u>4. Exterior Cladding (continued)</u>	QUANTITY	UNIT	RATE	\$
Interior finish to exterior walls				
Gypsum board, taped and textured	22,456	SF	1.10	24,702
Paint gypsum board	22,456	SF	0.65	14,596
Windows and glazing	2,618	SF	12.00	31,416
Exterior doors, frames and hardware	14	EA	350.00	4,900
Paint exterior doors	14	EA	50.00	700
Exterior door trim	476	LF	2.00	952
Paint door trim	476	LF	1.00	476
Balcony rail cap	252	LF	4.00	1,008
				\$192,440
 <u>5. Roofing and Waterproofing</u>				
Waterproofing at slab	8,246	SF	0.50	4,123
Second floor balcony deck - dexotex	504	SF	6.00	3,024
Roofing insulation	9,044	SF	0.80	7,235
Roof				
Composition shingles	9,044	SF	1.50	13,566
Sheetmetal				
Gutters	560	LF	5.00	2,800
Rainwater leader heads	14	EA	30.00	420
Downpipes	280	LF	4.00	1,120
Flashing		LS		3,500
Caulking and sealants		LS		3,500
				\$39,288

QUANTITY	UNIT	RATE	\$
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6. Interior Partitions

Wood framed partitions

Wood studs 2" x 4" @ 16" O.C.

11,655	SF	1.50	17,483
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Partition surfacing

Gypsum board taped and textured

23,310	SF	1.10	25,641
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Paint gypsum board

23,310	SF	0.65	15,152
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Sound insulation at kitchen party wall and bathrooms

6,300	SF	0.50	3,150
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Interior doors, frames, hardware

3' x 6' hollow core

56	EA	250.00	14,000
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Closet sliders

42	EA	350.00	14,700
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Interior door trim

3,332	LF	2.00	6,664
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Paint door trim

3,332	LF	1.00	3,332
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\$100,122

7. Floors, Walls, Ceiling Finishes

Floors

Sheet vinyl at kitchen

1,274	SF	3.00	3,822
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Tile at bath

1,344	SF	12.00	16,128
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Carpet

13,874	SF	2.00	27,748
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Bases

Tile base

378	LF	4.00	1,512
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Resilient base

3,626	LF	1.00	3,626
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Walls

Ceramic tile at bath

1,834	SF	12.00	22,008
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Ceilings

Gypsum board taped, and textured

9,044	SF	1.30	11,757
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Paint gypsum board ceiling

9,044	SF	0.70	6,331
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\$92,932

	QUANTITY	UNIT	RATE	\$
<u>8. Equipment</u>				
Bath accessories				
Mirrors	294	SF	10.00	2,940
Medicine cabinets	28	EA	200.00	5,600
Toilet accessories	70	EA	30.00	2,100
Tub enclosure	14	EA	220.00	3,080
Closet shelf and pole	350	LF	7.00	2,450
Cabinets and countertops				
Kitchen cabinets				
Base	280	LF	130.00	36,400
Upper	280	LF	90.00	25,200
Plastic laminate countertop	280	LF	30.00	8,400
Bathroom vanities	14	EA	200.00	2,800
Home appliances				
Refrigerator	14	EA	700.00	9,800
Oven/cooktop	14	EA	600.00	8,400
Hood	14	EA	200.00	2,800
Microwave oven	14	EA	200.00	2,800
Garbage disposal	14	EA	120.00	1,680
Dishwasher	14	EA	450.00	6,300
				\$120,750

9. Exterior Stairs

Stairs				
Entry stairs - 1 flight	14	EA	1.0M	14,000
Handrails	210	LF	10.00	2,100
				\$16,100

	QUANTITY	UNIT	RATE	\$
<u>10. Plumbing</u>				
Bathtubs with shower	14	EA	600.00	8,400
Waterclosets	28	EA	200.00	5,600
Lavatories	28	EA	175.00	4,900
Kitchen sink with dishwasher and disposal connection	14	EA	500.00	7,000
Rough-in washer/dryer	14	EA	300.00	4,200
Rough-in plumbing fixtures	84	EA	200.00	16,800
Water heaters	14	EA	300.00	4,200
				\$51,100

<u>11. Heating, Ventilating, and Air Conditioning</u>	14	EA	2.0M	\$28,000
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<u>12. Electrical</u>	14	EA	2.5M	\$35,000
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<u>14. Site Preparation</u>				-0-
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15. Site Development

Vehicular paving and curbs				
Asphalt paving - parking	9,360	SF	1.50	14,040
Concrete curbs	1,640	LF	8.00	13,120
Pedestrian paving				
Concrete walkways	5,170	SF	3.00	15,510
Site drainage		LS		5,000
Site lighting				
1 per 50' pedestrian walk	14	EA	1.0M	14,000

	QUANTITY	UNIT	RATE	\$
<u>15. Site Development (continued)</u>				
Landscaping				
Fine grading and soil preparation	42,672	SF	0.15	6,401
Trees - large	33	EA	125.00	4,125
Trees - medium	16	EA	80.00	1,280
Shrubs - 1 bush/6 lf	292	EA	20.00	5,840
Fencing				
Patio	437	LF	12.00	5,244
Entry	50	LF	12.00	600
Tot playground		LS		70,000
Benches	10	EA	300.00	3,000
Carport	2,592	SF	10.00	25,920
				\$184,080

16. Site Utilities

Site electrical, telephone, water - allow \$49,000

APPENDIX B: TRAFFIC IMPACTS ON NEIGHBORING STREETS BY HOUSING
DEVELOPMENT ON ALAMEDA ANNEX SITE

ATTACHMENTS A THROUGH F: Refer to document, "TRAFFIC
IMPACT ANALYSIS TECHNICAL DATA" dated November 19, 1987

ROBERT CONRADT

TRAFFIC ENGINEER AND TRANSPORTATION PLANNING CONSULTANT
P.O. BOX 4268, SAN RAFAEL, CALIFORNIA 94913
(415) 479-2157

November 19, 1987

To: Sedway Cooke Associates

From: Robert Conradt, P.E., Consulting Engineer

Subject: TRAFFIC IMPACT ANALYSIS
ALAMEDA NAVY HOUSING STUDY

INTRODUCTION

This is a report on a traffic impact analysis for the Alameda Navy Housing Study project which proposes the construction of new housing units on the Alameda Annex site. The traffic analysis was carried out in accordance with an agreement, dated September 24, 1987, with Sedway Cooke Associates. The analysis consists of three parts, as follows:

1. Trip generation

An estimate was made of the amount of traffic that would be generated by the new housing units in the proposed Navy housing project.

2. Access points

Potential points of access to serve traffic going to and from the new housing project were identified.

3. Traffic impact

The effects that traffic generated by the new housing would have on peak-hour conditions on Atlantic Avenue and Webster Street were determined. 1

This report gives background information on the project site, roadways in the vicinity of the site, and the procedure used in the traffic analysis. The report then presents analyses of trip generation, access points and traffic impacts. More detailed information from various parts of the analysis is included in a set of attachments at the end of the report.

BACKGROUND INFORMATION

Project Site

The site of the proposed housing project is the existing Navy Supply Annex which is located as shown in Figure 1. It is in the City of Alameda within the area bounded by Webster Street, Atlantic Avenue, Main Street, and the Oakland Estuary. The project site is between two existing Navy housing areas -- North Housing and East Housing -- and abuts the northwest corner of the campus of the College of Alameda.

The Navy air base, NAS Alameda, is located west of Main Street. The most heavily used entrance to the base is the East Gate at Atlantic Avenue and Main Street. Additional entrances to the base are at Avenue C on Main Street, and the Main Gate, which is further north and west on Main Street.

Other land development projects in the vicinity of the housing project site are the Alameda Marina Village on the east side of Webster Street, and the Alameda Gateway (Todd Shipyard site) which is located on the estuary, north and west of the project site. The Marina Village development is currently under construction. The Gateway project is still being planned.

Other existing activities in the area that could have some effect on access plans for the project site are the Alameda facility of the Naval Supply Center Oakland, which is on the estuary north and east of the project site, and Mariner Square, which is also on the estuary, adjacent to the NSC Alameda Facility.

More detailed information on the immediate vicinity of the project site is shown on the aerial photo in Figure 2 and the maps in Figures 3 and 4.

Roadways

The principal streets for traffic access to the project site are Webster Street, Atlantic Avenue and Main Street. Webster Street is a divided roadway north of Atlantic Avenue. It has two lanes northbound, and three lanes southbound, including one lane marked exclusively for right turns onto Atlantic Avenue for traffic going west toward NAS Alameda.

Webster Street connects to the Webster Street and Posey Tubes, which pass under the Oakland Estuary. Each tube has two lanes,

and carries one-way traffic. The Posey Tube is for northbound traffic, and the Webster Street Tube is for southbound traffic. The tubes are the principal connection between Alameda and the rest of the region. Intersections at the Oakland end of the tubes can at times be the controlling factors with regard to traffic conditions in the tubes.

Atlantic Avenue is divided, and has two lanes in each direction. It currently ends in a three-way intersection at Webster Street. Atlantic Avenue carries most of the traffic going to and from NAS Alameda, and it goes directly into the East Gate of the air base through its intersection with Main Street.

Main Street lies along the east boundary of NAS Alameda. It is an undivided street with two lanes in each direction.

The traffic capacities of the principal streets in the study area are normally limited to the capacities of the signalized intersections on those streets, except that the roadways in the tubes and the connecting roadways at the ends of the tubes could govern the capacity under some conditions. Figure 5 shows the locations of intersections in the study area that are controlled by traffic signals.

Currently, traffic conditions in the area are sometimes affected by road construction work near the south end of the Posey Tube. The roadway system that connects to the Alameda ends of the tubes is currently undergoing significant changes.

The diagram in Figure 6 shows streets in the study area as they were before the current roadway changes began, which

is how they were when the traffic counts previous to those for this analysis were made.

Figure 7 includes the roadway changes that have already been constructed and are open to traffic. This is the roadway system as it was when the traffic counts for this analysis were made. The roadway changes include an overpass that carries southbound traffic on a new street that goes over Webster Street and into the Marina Village redevelopment area. The name of the new street was "Patton Way" in earlier plans, but is now "Constitution Way."

Construction of additional roadway changes is currently in progress. Figure 8 indicates the streets that will be in place when the construction is completed. Atlantic Avenue will extend to the east through the intersection with Webster Street, adding a fourth leg to that intersection. Constitution Way will continue through the Marina Village area, pass through an intersection with Atlantic Avenue, and end in the intersection of Lincoln Avenue and Eighth Street.

Analysis Procedure

The traffic analysis which is the subject of this report included the assembly and review of available plans, reports and traffic counts for the study area from the Cities of Alameda and Oakland, field observations of roadway and traffic conditions, traffic counts at intersections, derivation of traffic generation rates for the proposed housing project, preparation and analysis of alternative traffic access

schemes for the project site, estimation of the volume of traffic that the proposed new housing would add to the key intersections, and calculation of the change in the level of traffic service that the added traffic would cause at those intersections.

Roadway traffic counts in the study area made prior to this analysis and available from the City of Alameda are included with this report as Attachment A. Locations of the counts are shown in Figure 9.

Intersection counts made prior to this analysis and available from the City of Alameda are included in Attachment B. Counts available from the City of Oakland are in Attachment C. The locations of the included intersection counts made prior to this analysis are shown in Figure 10.

Locations of intersection counts that were made as part of this analysis are shown in Figure 11, and tabulations of the counts by five-minute intervals are included in Attachment D. Counts were made at 7 locations. Counts at locations 1, 2 and 3 were made for the purpose of determining trip generation rates for the existing North and East Housing. Counts at locations 4 and 5 were made to find out how much traffic uses the College of Alameda entrance at Atlantic Avenue during peak hours, and determine the suitability of Tinker Avenue as an access point for the housing project site. The counts at the Atlantic-Main and Atlantic-Webster intersections (locations 6 and 7) were made to provide data for calculating the traffic impacts of the proposed housing project.

Reduced copies of roadway plans furnished by the City of Alameda are in Attachment E. They show the planned future alignments and lane arrangements for Constitution Way and the Atlantic Avenue extension. Additional information provided by the City Traffic Engineer on plans for traffic signal installations are also included in Attachment E.

TRIP GENERATION

Peak hour trip generation rates for the proposed housing project were derived from traffic counts and observations at the access points for the existing East and North Housing areas. Peak hour traffic volumes to and from the housing areas were determined from the traffic counts made for this analysis (Attachment D). The A.M. peak hour counts are summarized in Figures 12 and 13. The P.M. peak hour counts are in Figures 14, 15 and 16.

A.M. peak hour counts of traffic through access points at Avenue C and at Third Street have a combined total of 264 vehicle trips. The combined total of average P.M. peak hour counts at the same locations is 321 vehicle trips. The P.M. peak hours are about 22 percent higher than the A.M. peak hours. Therefore, the P.M. peak is more critical, and a more appropriate basis for analysis, than the morning peak.

East Housing

The principal access points for East Housing are Avenue C at Main Street, and Third Street at Atlantic Avenue. These

intersections are controlled by traffic signals. Fifth and Cotati Streets at Atlantic Avenue can serve as additional access points to East Housing, but they are not signalized, and are very lightly used.

The combined totals of the highest hourly traffic volumes counted on Avenue C and Third Street in the P.M. peak period are 330 vehicles between 4:15 and 5:15 P.M., 331 between 4:30 and 5:30 P.M., and 298 between 5:00 and 6:00 P.M. Therefore, the highest hourly volume of traffic to and from the existing housing occurred between 4:30 and 5:30 P.M.

From observations made on field checks, it was estimated that any additional traffic through Cotati and Fifth Streets was less than about 10 percent of the total volume to and from East Housing. Assuming the actual counts represent 90 percent of the total, the highest hourly volume of vehicle trips on a normal weekday to and from existing East Housing was calculated to be about 370 vehicles, including 230 vehicle trips inbound (into the housing area), and 140 outbound (going out of the housing area).

There are 590 units in East Housing. Therefore, the P.M. peak hour trip end generation rates for existing housing are approximately 0.39 vehicle trips per unit inbound, and 0.24 outbound.

North Housing

Singleton Avenue at Main Street is the only access point for North Housing. However, there are other activities in the

same area that generate additional traffic through the same access point. The other activities are Miller School, a child care center, and a mini-storage facility. The trips generated by these other activities were estimated and subtracted from the counts at Singleton Avenue. The procedure provided an estimate of trips generated by North Housing, but the results may be somewhat less accurate than the estimate of trip end generation rates for East Housing.

Miller School includes elementary grades and kindergarten. There are approximately 480 children enrolled, all of Navy families. Most of the children walk to school, but there is one small bus. The last students leave about 2:45 P.M. At the time of the counts, there were about 30 vehicles parked inside the school fence, presumably the vehicles of school staff and visitors.

The child care center next to the school has children from about 100 families each day. A staff member at the center estimated the peak periods for vehicle trips to and from the center are about 6:30 to 9:00 A.M. and 3:30 to 6 P.M. There were 13 vehicles parked at the center in late morning at the time of the counts.

The mini-storage facility has 1,100 units. The manager estimated that an average of about 80 trips pass through the gate daily, with the peak period occurring between 4:00 and 6:00 P.M.

It is estimated that these generators in the north housing area account for about 70 of the counted inbound trips and 70 of the outbound, reducing the number generated by the

housing to 112 inbound and 69 outbound in the P.M. peak hour. There are 282 dwelling units in North Housing. Therefore, the P.M. peak hour trip rates per dwelling unit are 0.40 inbound and 0.25 outbound. These rates agree with those derived from the East Housing counts.

Comparisons

Average trip generation rates for several types of housing are listed in a report of the Institute of Transportation Engineers (ITE)*. The rates are based on studies in various states. Many of the studies were made in California. The highest rates are for single-family detached housing, for which the average P.M. peak hour trip end generation per dwelling unit is given as 0.63 inbound and 0.37 outbound. The rates from individual studies range from 0.3 to 1.8 inbound, and 0.1 to 1.2 outbound. Average P.M. peak hour rates for apartments are listed in the ITE report as 0.4 inbound and 0.2 outbound, with rates for individual studies ranging from 0.1 to 0.8 inbound, and 0.1 to 0.5 outbound.

The rates found in this analysis for existing housing in the Navy Annex appear reasonable in relation to the ITE rates, considering the characteristics of the Navy housing. A large percentage of the heads of household in the Annex area are assigned to NAS Alameda. For these persons, the work place is close, and car pooling is relatively easy to arrange. In addition, some are assigned to ships in the Fleet, and are away part of the time. Work trips to other areas are likely

* TRIP Generation (Third Edition), An Informational Report, Institute of Transportation Engineers, 1983.

to be to other military installations so that car pooling is still a reasonable method of travel. For non-work trips, the Post Exchange, Commissary, schools and other facilities are nearby, and can be reached by walking, bicycle, or riding as a passenger with another driver, rather than driving alone. These factors work to reduce the generation of trips, so the rates found in this analysis appear reasonable when compared to trip generation rates for other types of housing in other areas.

Trip Distribution

East Housing counts were used to determine the directional distribution of vehicle trips to and from the existing housing. The North Housing counts were not useful for that purpose because they included trips generated by other activities that would have different trip distribution patterns. A percentage distribution of trips was estimated from the proportion of trips making the various directional moves at the Avenue C and Third Street intersections. The results were used to distribute the additional traffic that would be generated by the proposed new housing at the project site.

Proposed Housing

Plans for the proposed housing project call for the construction of 960 new housing units on the project site. Applying P.M. peak hour trip end generation rates of 0.40 for inbound, and 0.25 for outbound vehicle trips, the volume of trips generated by the new housing is estimated to be approximately

380 inbound, and 240 outbound. The volume of traffic added by the new housing to streets and intersections in the vicinity of the project site was estimated on the basis of the trip distribution percentages for existing housing. The results are shown on Figure 17 for inbound trips, and on Figure 18 for outbound trips.

The heaviest volume of traffic to the project site from one approach road is 95 vehicles per hour (vph) southbound on Webster Street (Figure 17). This traffic could be handled easily in the Webster Street-Atlantic Avenue intersection on the separate right turn lane provided in the future plan for the intersection. The northbound volume on Webster Street is 40 vph, which is a relatively small volume (possibly one vehicle per signal cycle on the average), but it adds to the critical left turn from the west on Atlantic Avenue to Webster Street northbound. In the morning peak hour, the left turn volume would be higher, but it would occur at a less critical time.

A large portion of the trips go to and from the air base. Inbound trips to the new housing area from the air base add up to 180, which is about 47 percent of the total inbound trips. The outbound trips from the housing area to the base are 100, or about 42 percent of the outbound total.

ACCESS POINTS

The purpose of this analysis is to identify possible access arrangements for the project site. It is not the intention of the analysis to select one particular access scheme, or to

recommend a specific internal street arrangement within the housing area. Those decisions are to be made later.

The housing concept developed on the project site by Sedway Cooke Associates calls for two parallel streets within the housing area located approximately as indicated by the dashed lines in Figure 19. In this analysis, a series of alternative access schemes was prepared by connecting access points to the proposed internal streets within the project site in various combinations and alignments, and examining each scheme with regard to its appropriateness to serve residents of the new housing area, its effects on the adjacent existing housing areas, and its connections to, and likely impacts on, streets outside the housing areas.

There are five possible access points for the project site, as shown in Figure 19. They are Singleton Avenue, Avenue C, Decatur Street, Fifth Street, and Tinker Avenue. It is conceivable that any one of these access points could be used alone, or in combination with one or more of the other four potential access points.

Avenue C crosses Main Street at one point through a signalized intersection and enters the air base at a convenient location for residents in the housing areas east of Main Street. Avenue C is a very useful and desirable access point for the project site.

Fifth Street has a median opening on Atlantic Avenue, but there is no traffic signal, and there is no separate left turn storage lane on Atlantic Avenue, at that intersection. There appears to be adequate open space along the fence line between

the East Housing and the College of Alameda campus to accommodate the extension of Fifth Street northward into the project site without disrupting the existing housing units near that route. Fifth Street is a convenient access point for most of the resident trips that are not going to or from the air base. It has some problems, however, including heavy traffic volumes at peak times on Atlantic Avenue, the close proximity of the college entrance, and the lack of traffic signal control, and lack of a left turn lane. Use of Fifth Street could require expenditures for improvements. If not carefully aligned and connected within the housing area, the extension of Fifth Street could attract through traffic to use it as a bypass route to avoid congestion on Atlantic Avenue and Main Street.

Tinker Avenue is the access point most likely to attract through traffic into the housing area. It would provide a very direct and convenient route into the project site from the Webster Street Tube. However, the right turns from Webster Street at Atlantic Avenue, and from Atlantic Avenue at Fifth Street are easily made and are not likely to be congested at the times when residents of the housing project would be making those maneuvers.

North and East Housing are now separated from each other by the Supply Annex. When the Supply Annex is replaced by the new housing project, it will become possible to link the three housing areas by means of an internal street, enabling residents to circulate within the residential areas and reach commonly used facilities such as the school, child care center, and playgrounds without leaving the housing area and driving on Main Street or Atlantic Avenue. Singleton Avenue between

Main Street and the Mosley Avenue intersection is the only street segment available in the North Housing area where an internal street connection could be made to the other two housing areas. The most logical location available for a connection from Singleton Avenue into the East Housing area is at Decatur Street. In this analysis, all access schemes include an internal street that connects Singleton Avenue to Decatur Street.

A Decatur Street connection to the project site provides access to Atlantic Avenue through Bainbridge Avenue and Third Street. There is a traffic signal at the intersection of Third Street and Atlantic Avenue. It is a four-way intersection. There are no separate left turn lanes on Atlantic Avenue. There is an active pedestrian crossing across Atlantic Avenue to the elementary school on the south side. There is a busy driveway next to the school on Third Street just south of Atlantic Avenue. Turns in and out of the driveway and cars double parked on Third Street in front of the school at certain times cause some congestion and conflicts with other vehicles using the Atlantic-Third intersection.

Alternative Access Schemes

Eight basic access arrangements are possible using various combinations of Singleton Avenue and Decatur Street in combination with the other three access points -- four with a Tinker Avenue connection, and four without it. Table 1 lists the eight basic access schemes showing which access points are included in each scheme. Figures 20 through 30 are sketches that illustrate the basic access arrangements.

TABLE 1

 ACCESS POINTS INCLUDED IN EACH ACCESS SCHEME

ACCESS SCHEME NUMBER	ACCESS POINTS INCLUDED IN SCHEME			
	SINGLETON AND DECATUR	TINKER AVENUE	AVENUE C	FIFTH ST.
1 (A,B,C)	X	X	X	X
2 (A)	X	X	X	
3 (A)	X	X		X
4 (A)	X	X		
5 (A,B)	X		X	X
6 (A)	X		X	
7 (A)	X			X
8 (A)	X			

Scheme 1(A) (Figure 20) includes all five access points and connects them in the simplest and most direct way. The resulting intersection on Singleton Avenue is too close to Main Street, and visibility would be blocked because of the curvature on Singleton Avenue and the building on the southeast corner of Singleton Avenue and Main Street. The three intersections on Decatur Street near Avenue C are too close together. Through traffic would be attracted into the housing area because of the directness of connections between Avenue C and Tinker Avenue, and between Avenue C and Fifth Street.

Scheme 1(B) (Figure 21) changes the alignment of Decatur Street to improve the intersections.

Scheme 1(C) (Figure 22) further changes the street alignments in order to discourage through traffic. Bainbridge Avenue is terminated in a cul-de-sac at Fifth Street to discourage through traffic from using Bainbridge Avenue.

Scheme 2(A) (Fig. 23) eliminates the connection to Fifth Street and utilizes a more circuitous route between Singleton Avenue and Decatur Street.

Scheme 3(A) Fig. 24) cuts off the connection to Avenue C to discourage through traffic between Tinker Avenue and Avenue C, and to improve the intersection spacing on Decatur Street.

Scheme 4(A) (Figure 25) eliminates both the Avenue C and Fifth Street access points in order to discourage through traffic from passing through the housing area when going between Tinker Avenue and Avenue C, and between Fifth Street and Avenue C.

Schemes 5 through 8 do not have access at Tinker Avenue. Scheme 5(A) (Figure 26) maintains access at both Avenue C and Fifth Street. The route between those two access points could be attractive to through traffic.

Scheme 5(B) (Figure 27) changes the alignment of the Avenue C connection and the locations of its intersections with the Decatur Street to Singleton Avenue connection, but the route between Avenue C and Fifth Street could still be attractive to through traffic.

Scheme 6(A) (Figure 28) removes access from the project site to Fifth Street, but retains access to Avenue C.

Scheme 7(A) (Figure 29) provides access to Fifth Street and removes access to Avenue C.

Scheme 8(A) (Figure 30) provides access to the new housing area only through the Singleton Avenue-Decatur Street connection.

Comparison of Access Schemes

Table 2 is a summary of a preliminary evaluation for this analysis in which the alternative access schemes are compared. The schemes are rated on the basis of their provisions for internal linking within the Annex housing areas, convenience of access to external areas for residents of the housing area, and reduction of the potential for through traffic on the residential streets.

TABLE 2

PRELIMINARY RATING OF ALTERNATIVE ACCESS SCHEMES

Rating By Performance Evaluation Criterion							
Access Scheme	Internal Linking			External Access, to:			Reduction of Through Traffic
	Convenience	Low Resident Traffic	Safety	NAS Ave.C	Atlantic Avenue	Webster Street & Tubes	
1(A)	3	4	0	4	4	4	0
1(B)	4	4	3	4	4	4	0
1(C)	3	2	0	3	3	4	0
2(A)	0	0	2	2	0	4	1
3(A)	4	3	4	0	3	4	2
4(A)	4	0	4	0	0	4	3
5(A)	4	4	3	4	4	2	2
5(B)	4	3	2	3	4	2	2
6(A)	3	1	2	3	0	0	4
7(A)	3	4	3	0	4	2	4
8(A)	3	0	3	0	0	0	4

Note: Highest rating is 4; lowest is 0.

Internal Linking

The suggested criteria for evaluating internal linking are:

(1) convenience of internal circulation and access among the various parts of the three Annex housing areas for the residents, (2) minimizing of concentrations of resident traffic on particular street segments within the housing area, and (3) safety -- particularly safety with regard to adequate distances between intersections, and potential confusion and conflicts associated with intersection turning maneuvers.

External Access

Although Singleton Avenue and Decatur Street (through its connection to Bainbridge Avenue and Third Street) can provide external access for the project site, Singleton Avenue is not as direct a connection to the air base as Avenue C, and Decatur Street must carry internal traffic through the housing areas along Bainbridge Avenue and Third Street to reach Atlantic Avenue. The three remaining access points -- Avenue C, Fifth Street and Tinker Avenue -- provide more direct access to external areas, and are given higher ratings than Singleton Avenue and Decatur Street for convenience of resident access to external areas.

Through Traffic

Any internal street arrangement that forms a direct route through the residential area will be attractive to through traffic that could bypass congestion points on the external

street system. A direct route from Tinker Avenue to Avenue C would attract drivers traveling from the Webster Street Tube to the NAS gate at Avenue C. The route through the Annex housing area would be shorter than using Webster Street to Atlantic Avenue and Main Street, and would allow drivers to avoid the intersections on Atlantic Avenue at Webster, Poggi, Third, and Main Streets.

Each scheme is given a comparative rating for its capability in each of the items of evaluation, (represented by columns) in Table 2. The ratings for individual items range from 0 to 4. The lowest rating is 0, and the highest is 4.

In addition to the ratings, each evaluation category and evaluation item is assigned a weight. The sum of the weights is 100, so each item weight represents that item's importance as a percentage of all criteria used in evaluating the scheme.

Table 3 lists the weights multiplied by the ratings. The sums of the weighted ratings are listed in the total column at the right side of Table 3 for each of the schemes compared.

Scheme 7(A) has the highest weighted rating, which is 325, and would be considered the best of the access alternatives if the ratings and evaluation weights used in the tables were assumed. Schemes 5(A) and 6(A) are tied for second best. The least desirable schemes are Schemes 1(C), and 2(A).

Most of the schemes without Tinker Avenue access score higher because of the high weight assigned to reducing the potential for through traffic. Other criteria, ratings and evaluation weights might be used, but those used in this analysis have

TABLE 3

COMPARATIVE EVALUATION OF ALTERNATIVE ACCESS SCHEMES
(Relative weights of criteria shown in parentheses)

Weighted Ratings By Performance Evaluation Criteria

Access Scheme	Internal Linking (20)			External Access (30)			Reduction of Through Traffic (50)	Total
	Conven- ience (5)	Low Resident Traffic (5)	Safety (10)	NAS Ave.C (10)	Atlan- tic Avenue (10)	Webster Street & Tubes (10)		
1 (A)	15	20	0	40	40	40	0	155
1 (B)	20	20	30	40	40	40	0	190
1 (C)	15	10	0	30	30	40	0	125
2 (A)	0	0	20	20	0	40	50	130
3 (A)	20	15	40	0	30	40	100	245
4 (A)	20	0	40	0	0	40	150	250
5 (A)	20	20	30	40	40	20	100	270
5 (B)	20	15	20	30	40	20	100	245
6 (A)	15	5	20	30	0	0	200	270
7 (A)	15	20	30	0	40	20	200	325
8 (A)	15	0	30	0	0	0	200	245

a reasonable, although subjective, basis, and serve to demonstrate an effective procedure for comparing access schemes.

Tentative Conclusions

The following tentative conclusions can be drawn from this identification and analysis of access arrangements. An internal street connecting Singleton Avenue to Decatur Street is desirable for internal circulation. Avenue C is a most desirable location for an access point to the new housing area. Another access point is needed to Atlantic Avenue, preferably at Fifth Street, although improvements may be needed on Atlantic Avenue to accommodate access at either Fifth Street or Third Street, or both. Tinker Avenue is not a desirable access point for the housing area because it is likely to attract through traffic to the residential streets.

TRAFFIC IMPACTS

Possible traffic impacts of the proposed new housing project were estimated by assigning the peak hour traffic that would be generated by the housing to the appropriate external streets and intersections. Impacts were calculated for two alternatives, access Schemes 1(C) and 5(A), in order to determine the range of possible traffic impacts.

Counts of existing traffic were used to establish the existing traffic conditions and a basis for comparisons against projected future conditions. The following are descriptions of the traffic counts and impact calculations.

Roadway Traffic Counts

The roadway counts in Attachment A show variations in weekday traffic volumes on Webster Street, Atlantic Avenue and Main Street by hour, season, and year for counting periods in Spring, Summer, and Autumn from 1985 to 1987. The volumes are heaviest on Webster Street between Atlantic Avenue and the tubes.

On Webster Street north of Atlantic Avenue, in the northbound direction, the peak hour volumes range from 2,262 to 2,530 vehicles per hour (vph) in the A.M., and 2,523 to 3,582 in the P.M. The peak hours occur between 7:30 and 8:30 A.M., and in the period from 3:00 to 4:30 P.M.

In the southbound direction, the peak hour volumes range from 2,402 to 3,162 vph in the A.M., and 1,715 to 3,041 vph in the P.M. The southbound peak hours occur between 6:00 and 7:00 A.M., and in the period from 4:40 to 6:00 P.M.

The peaking of southbound volumes in the morning, and northbound volumes in the evening are caused by traffic to and from NAS Alameda. The peaks northbound in the morning and southbound in the evening are caused by residents of Alameda who work across the estuary. Although the fluctuations of peak hour volume by season and year are somewhat irregular, the general trend appears to show the Navy peaks remaining constant or reducing slightly, and the resident peaks increasing.

The heaviest combination of conflicting traffic flows occurs in the afternoon at the Atlantic-Webster intersection when the

outgoing Navy traffic turns left across incoming resident traffic, which causes a continuously high concentrations of traffic from about 3:00 to 6:00 P.M., although the two conflicting flows are not at their highest volumes at the same time. The highest hourly combination of volumes seems to occur between about 3:30 and 5:30 P.M.

On Atlantic Avenue, the peak hour traffic counts range from 1,826 to 2,602 vph in the westbound direction between 6:00 and 7:00 A.M., and from 1,418 to 1,537 vph in the eastbound direction within the period between 3:00 and 4:30 P.M.

Intersection Traffic Counts

The peak hour volumes counted for this analysis at the Atlantic-Webster intersection are shown in Figure 31. They are comparable to counts made in 1984 and 1986 (Attachment B, pages B-1 to B-6), but are slightly lower.

Based on criteria for level of service in TRB Circular 212*, the existing traffic in the Atlantic-Webster intersection at the time of the count was operating at level of service C. The calculation is shown in Figure 32. An effective discussion of traffic conditions at the Atlantic-Webster intersection, and on related streets, as well as an explanation of the levels of service, is contained in excerpts from the City of Alameda 1984 Draft EIR Supplement for the Marina Village, which are included with this report in Attachment F.

* Transportation Research Board, Transportation Research Circular Number 212, Interim Materials on Highway Capacity, January, 1980.

Future Traffic

Future P.M. peak hour traffic volumes in the Atlantic-Webster intersection, including the effects of the Marina Village and other projects, and of the completed future roadway system, with the Atlantic Avenue and Constitution Way extensions, are contained in the Marina Village Draft EIR Supplement of 1984. Diagrams of current and future volumes from that report are in Attachment F. Figure 33 shows a calculation of level of service D for the Atlantic-Webster intersection, based on the projected future P.M. peak hour volumes and the planned future roadway system, which is for a conditions without the new Navy Annex housing.

Impsct of New Housing

Figure 34 shows the projected future traffic in the Atlantic-Webster intersection with the new housing-generated traffic added, for access Schemes 1(C) and 5(A). There is virtually no difference in the calculated level of service between the two schemes, or between the conditions with and without the new housing project. However, it is worth noting that the right turn from north to west is heavy, and, although it is not one of the critical moves with respect to the signal control, it increases about 10 percent with Scheme 5(A).

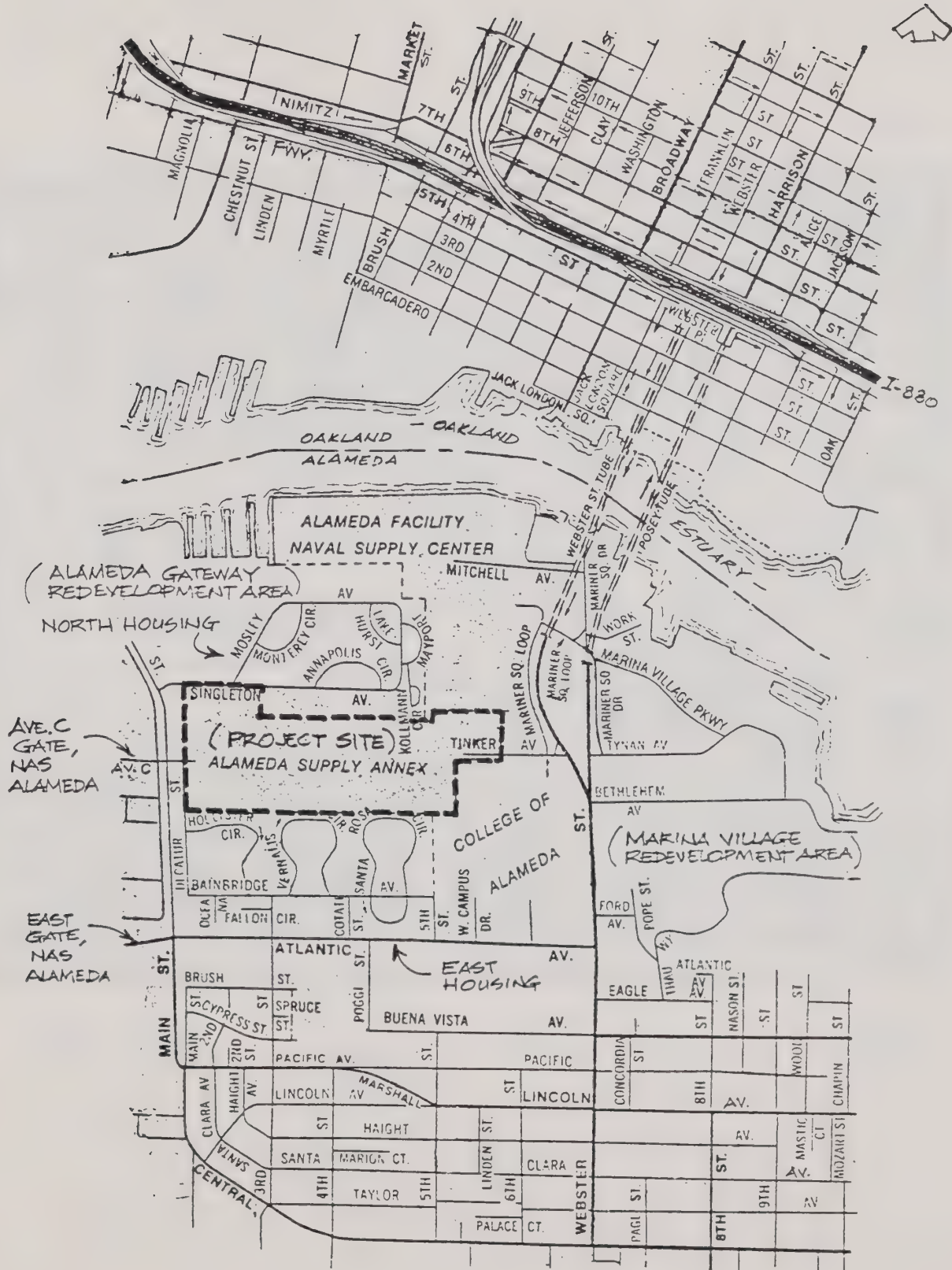


FIGURE 1

LOCATION OF PROJECT SITE
(From 1985 mapping)

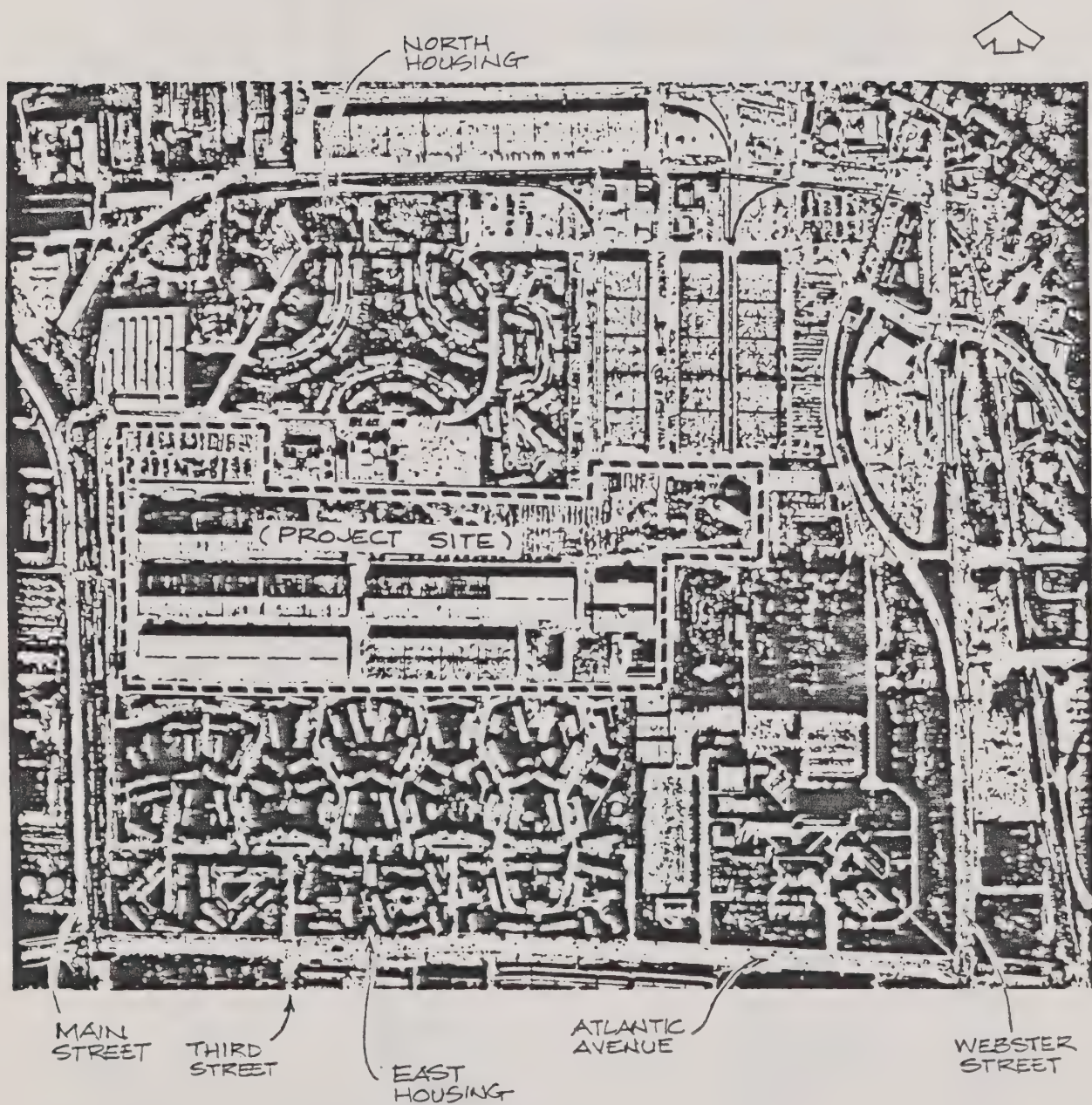


FIGURE 2

AERIAL PHOTO OF PROJECT SITE
(Photo probably taken about 1985)

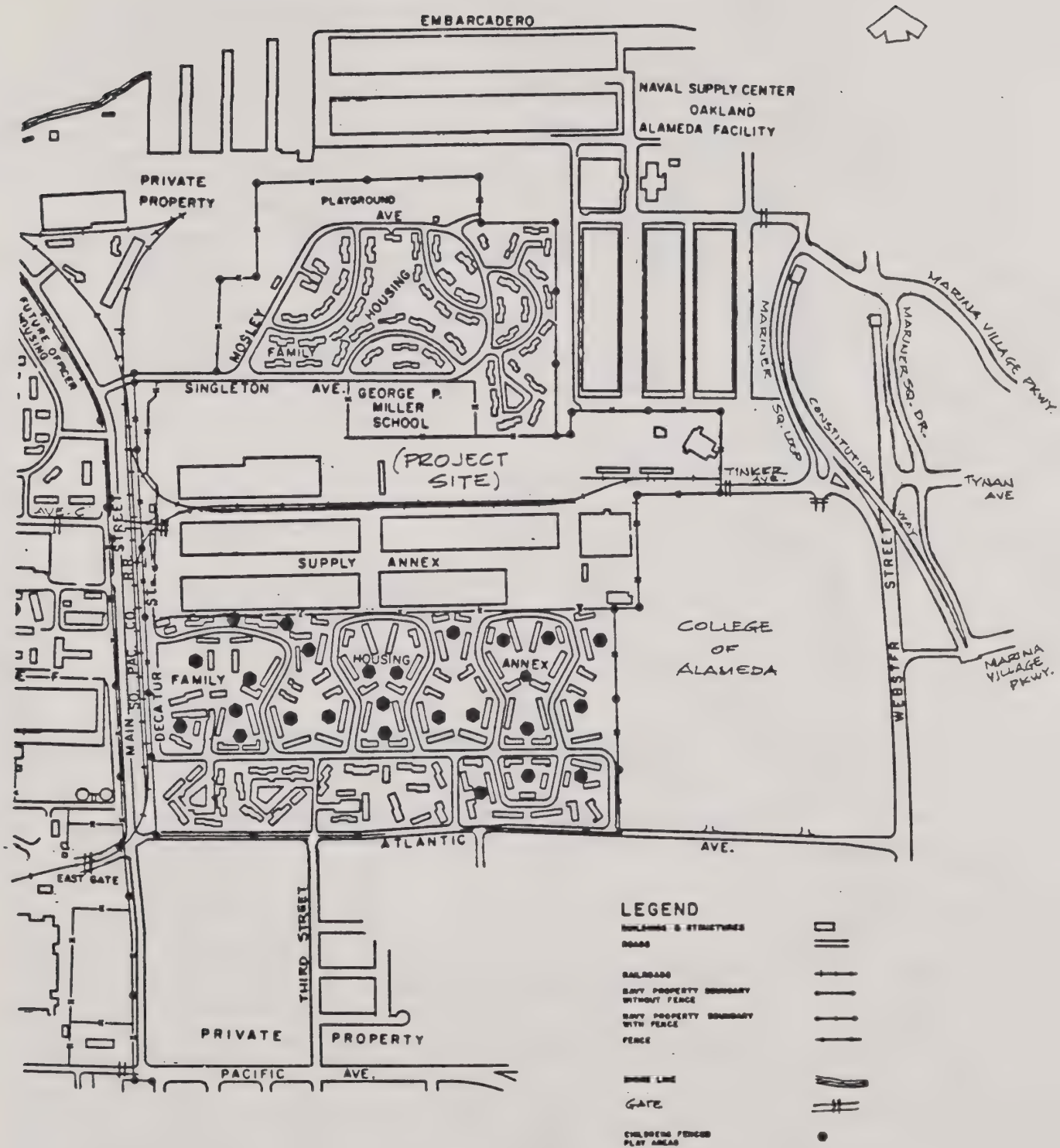


FIGURE 3

PROJECT SITE AND ADJACENT HOUSING

(From Navy mapping, plus street changes in place at time of this analysis, October and November, 1987)

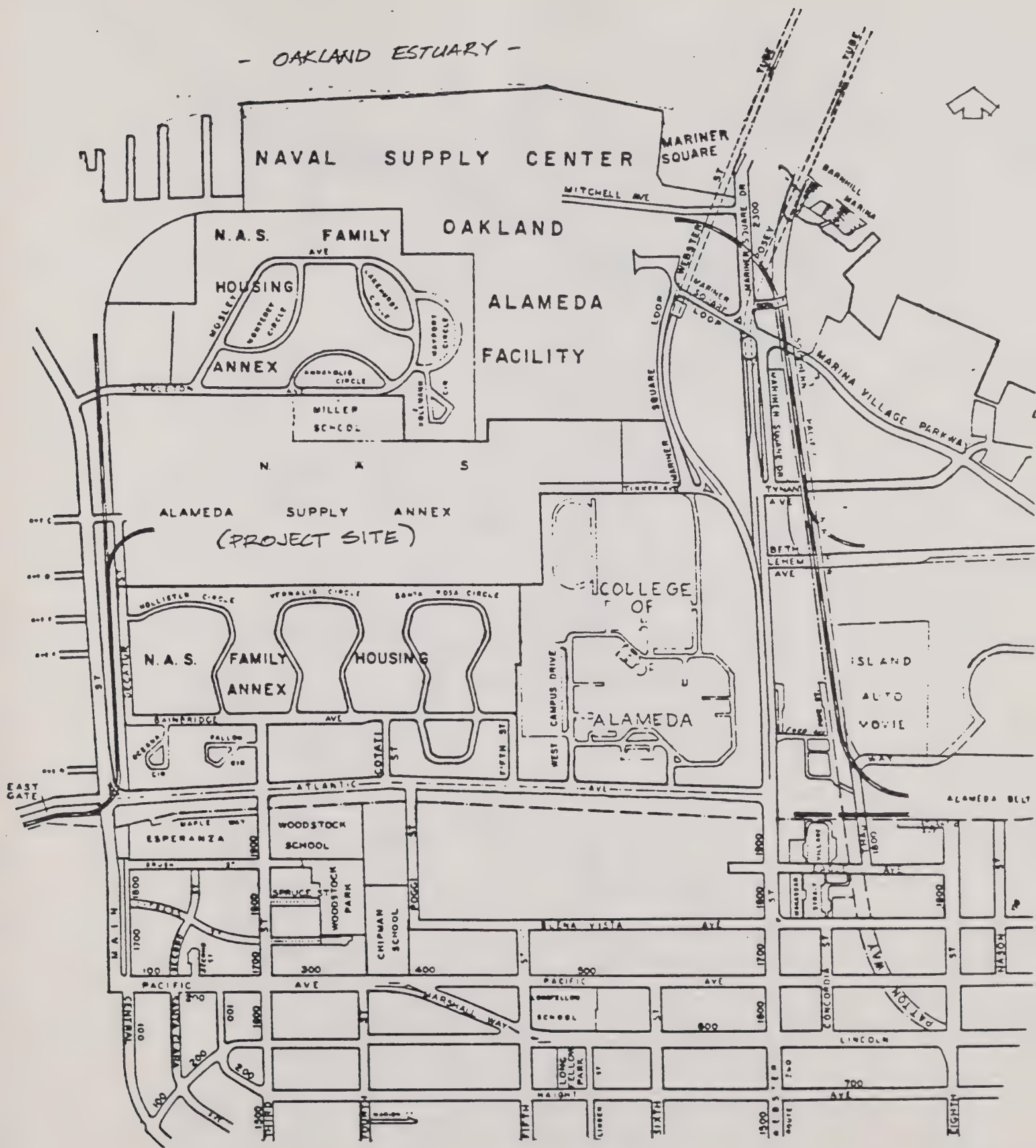
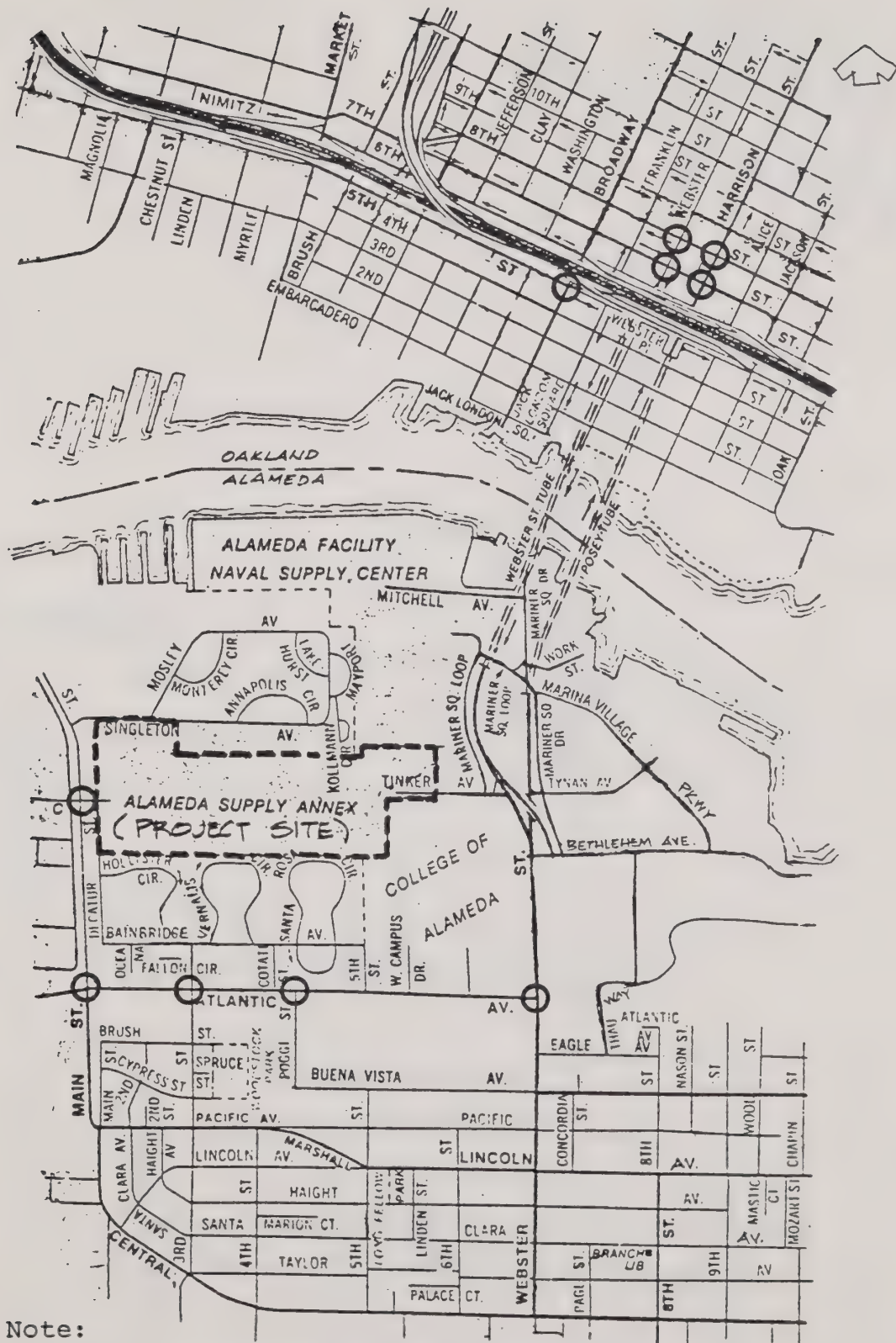


FIGURE 4

AREA OF PROJECT SITE

(From City map. Represents existing conditions prior to this analysis)



Note:
 0 circle denotes signalized intersection

FIGURE 5

SIGNAL-CONTROLLED INTERSECTIONS THAT AFFECT
 THE STUDY AREA

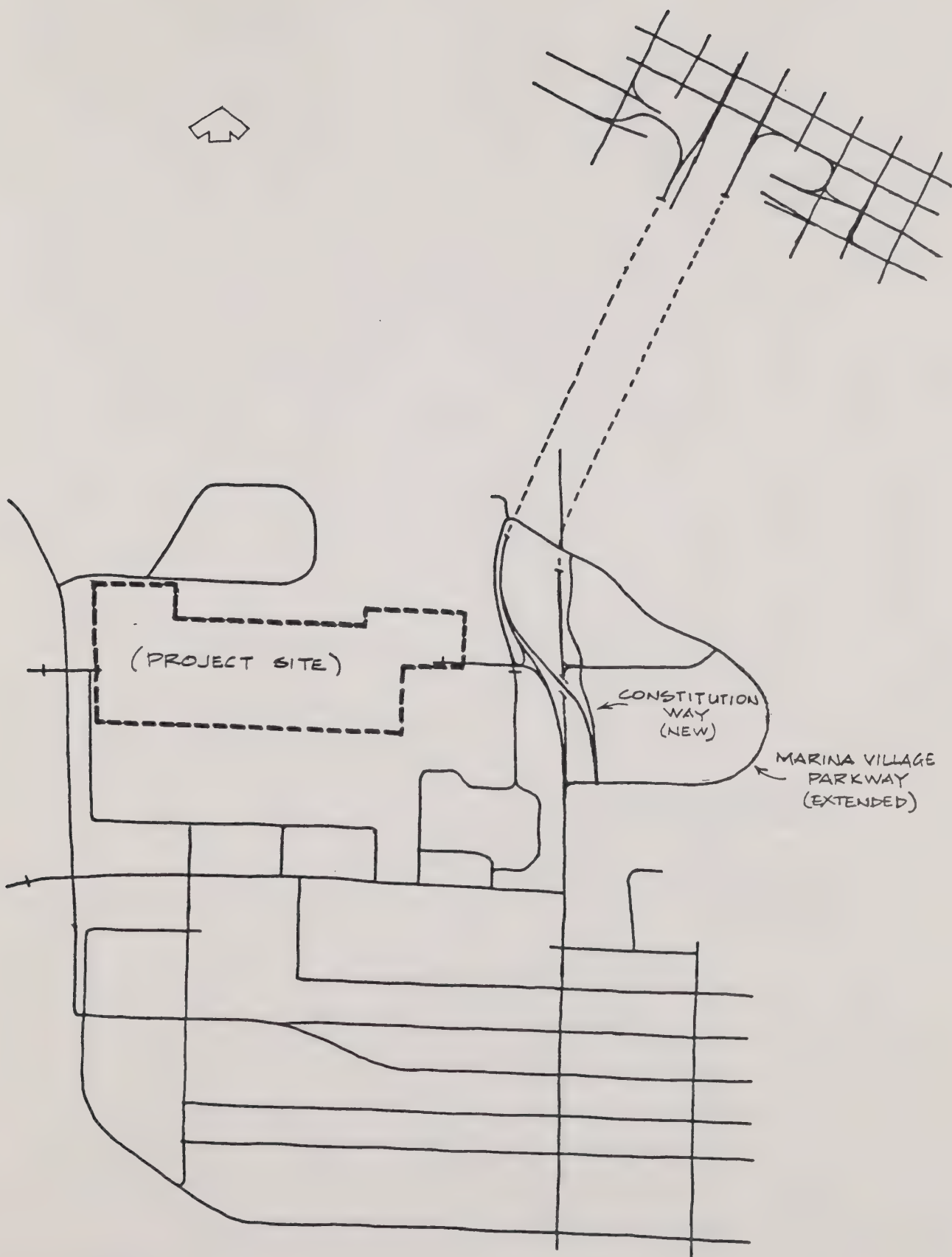


FIGURE 7
STREET SYSTEM EXISTING DURING THIS ANALYSIS

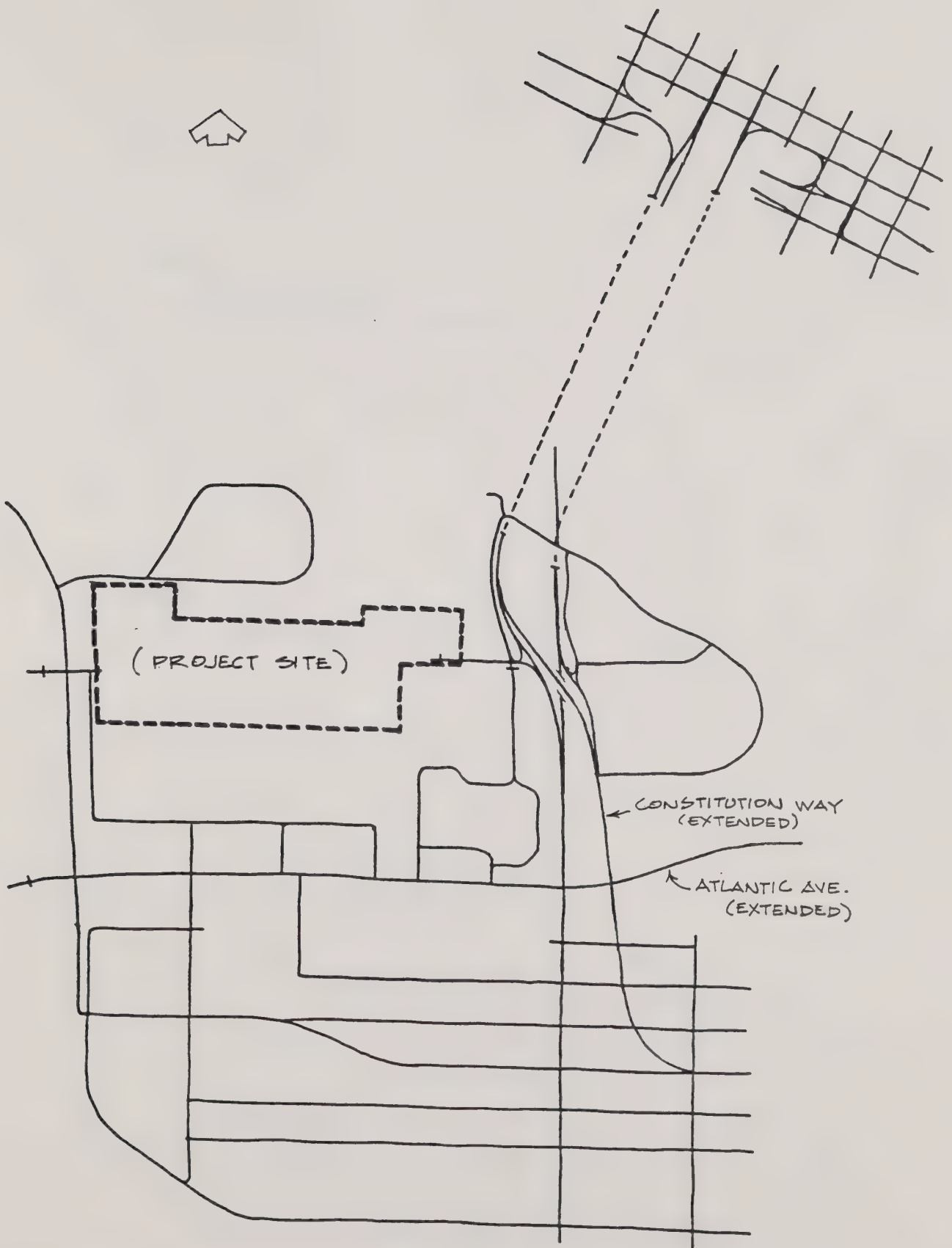


FIGURE 8

FUTURE STREET SYSTEM NOW UNDER CONSTRUCTION

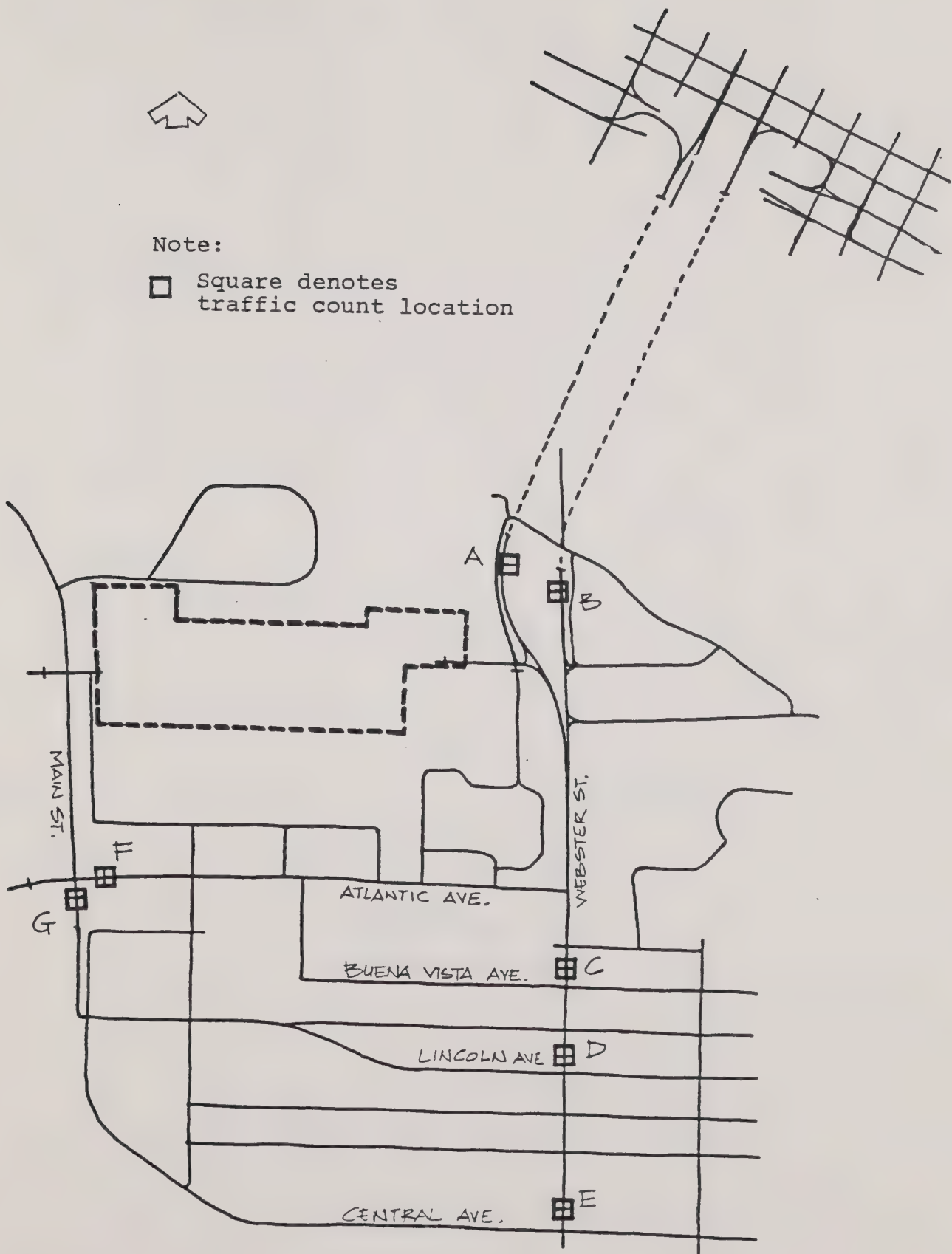


FIGURE 9

LOCATIONS OF ROADWAY TRAFFIC COUNTS
(Counts by City of Alameda, included in Attachment A)



NOTE:

○ CIRCLE DENOTES
COUNT LOCATION

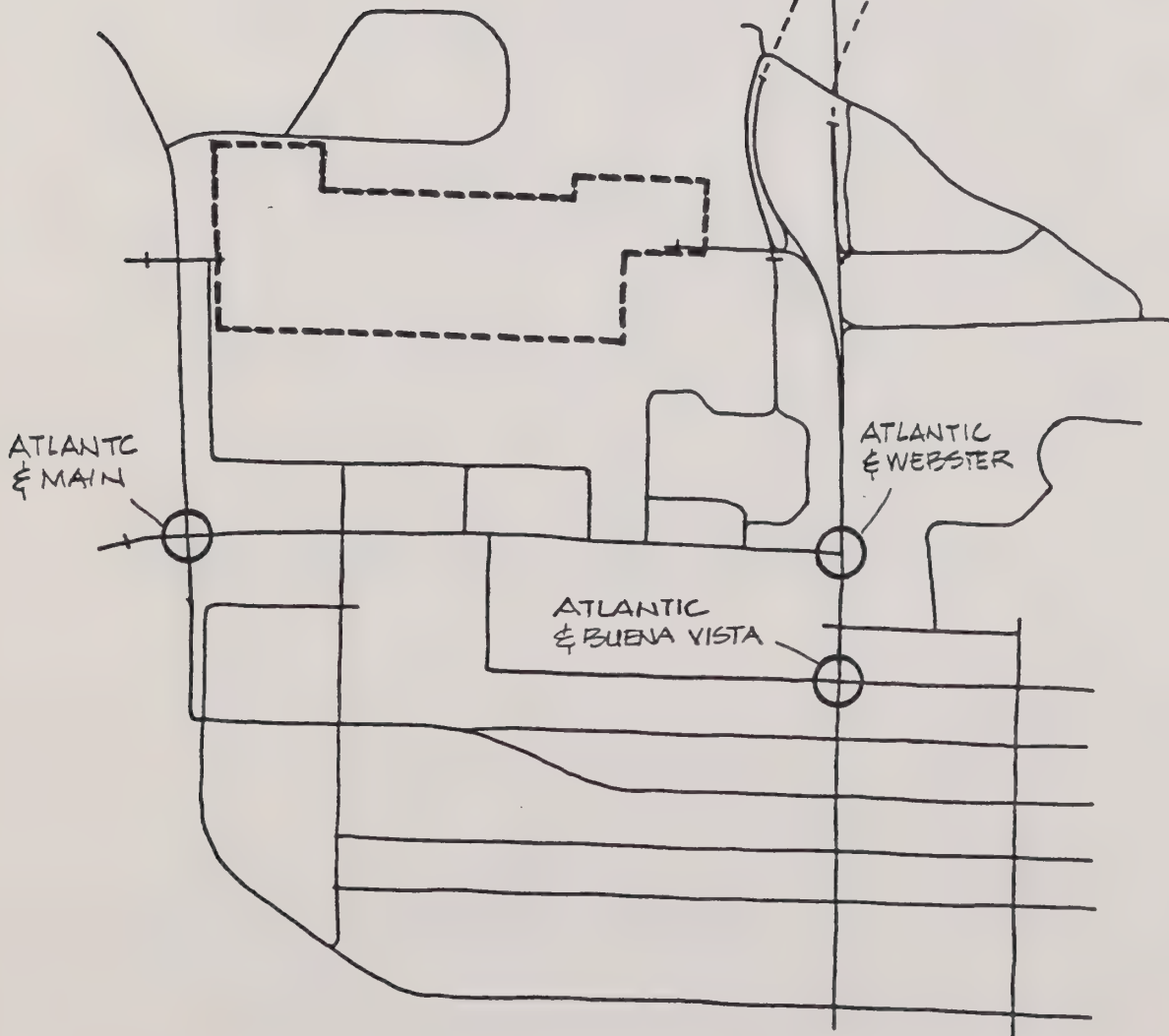


FIGURE 10

LOCATIONS OF INTERSECTION TRAFFIC COUNTS
MADE PRIOR TO THIS ANALYSIS
(Counts included in Attachments B and C)

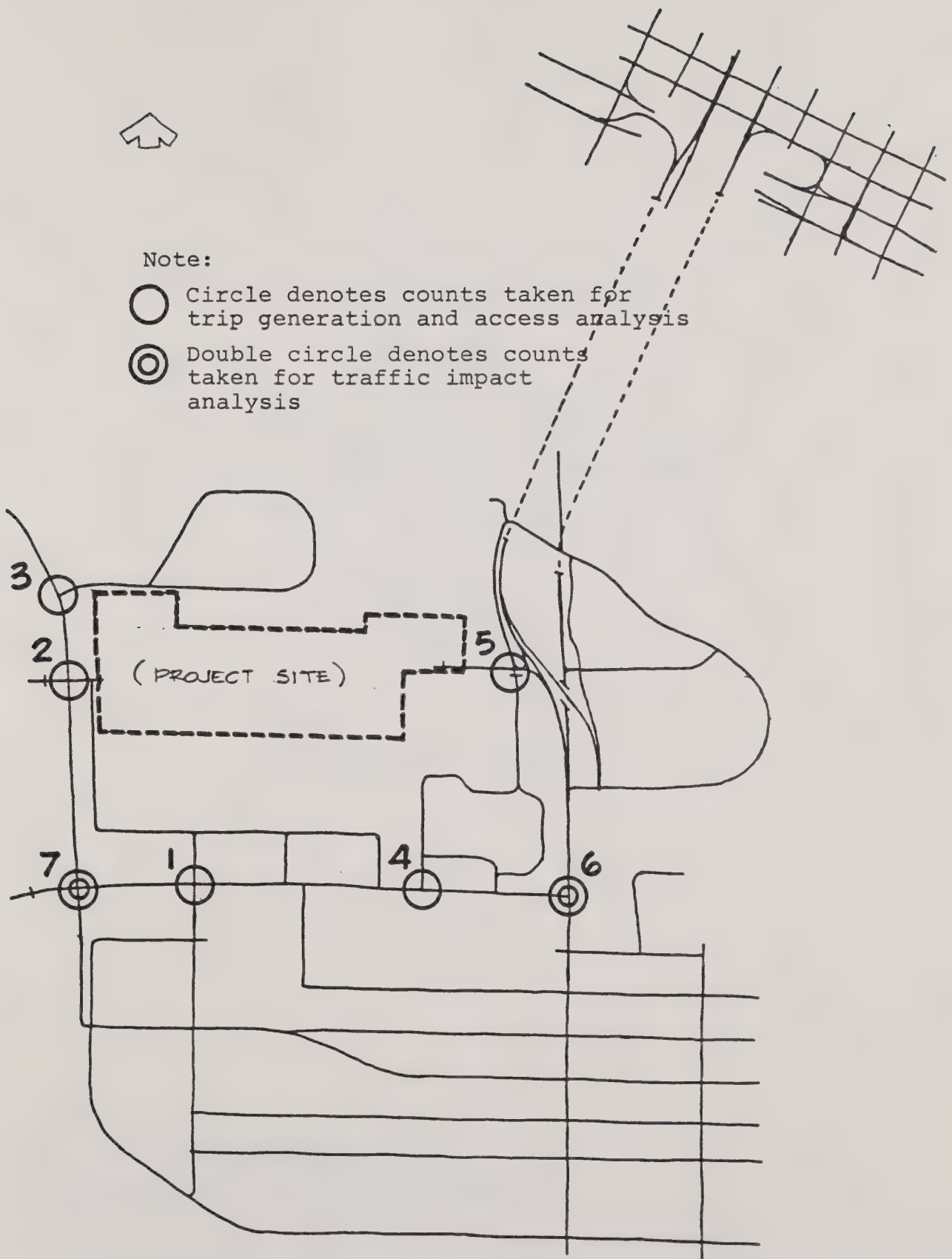
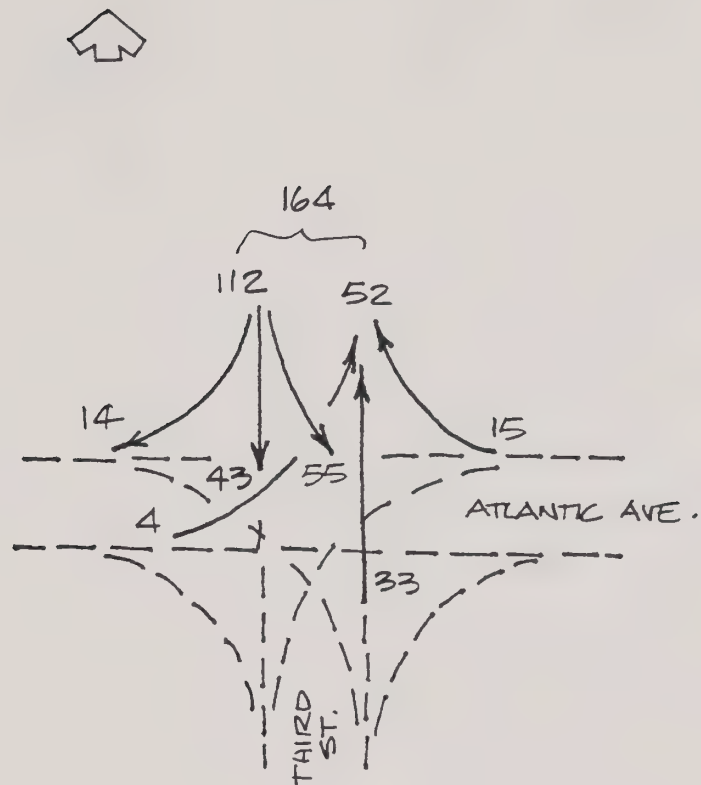


FIGURE 11

LOCATIONS OF INTERSECTION COUNTS FOR THIS ANALYSIS
(Counts included in Attachment D)

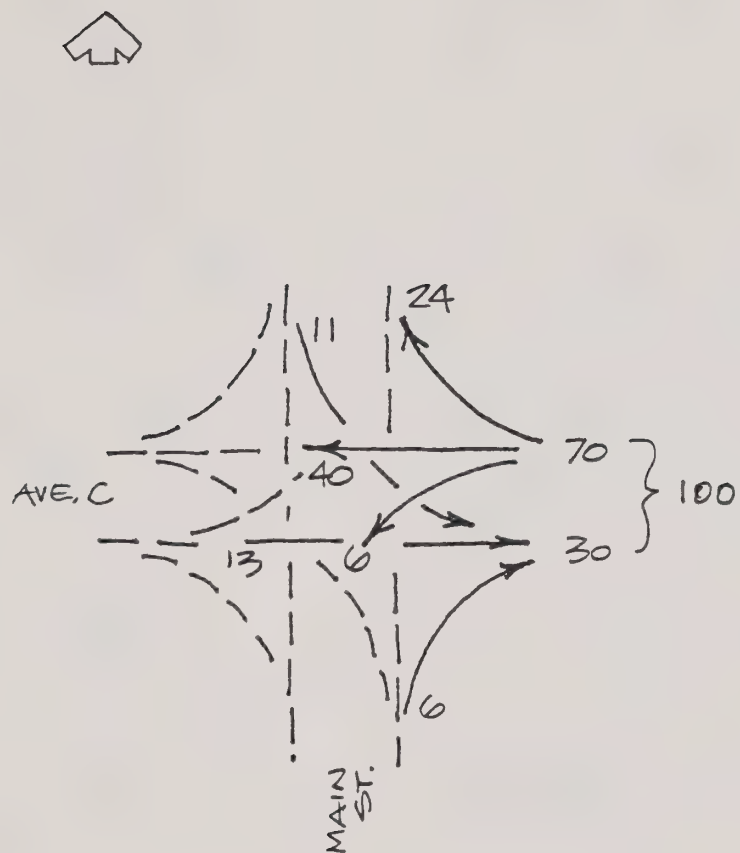


COUNT 1A

7:30-8:30 A.M., FRIDAY

FIGURE 12

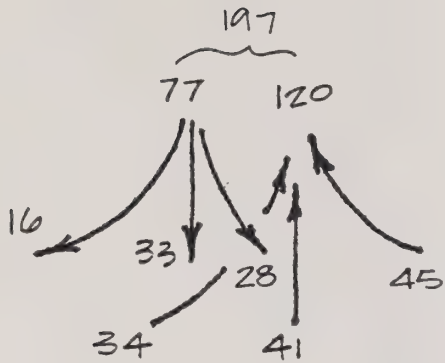
A.M. PEAK HOUR TRAFFIC COUNT
 TRIPS TO AND FROM EAST HOUSING
 ON THIRD STREET AT ATLANTIC AVENUE
 (From counts for this analysis, data in Attachment D)



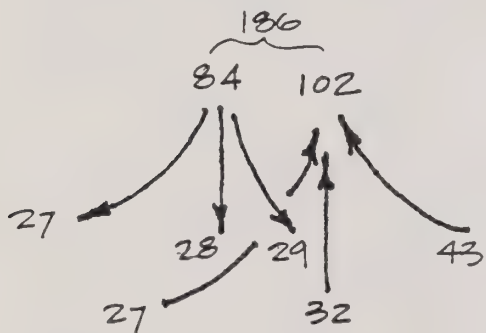
COUNT ZA
6:45 - 7:45 A.M., FRIDAY

FIGURE 13

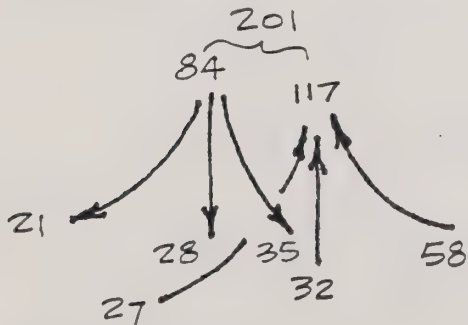
A.M. PEAK HOUR TRAFFIC COUNT
TRIPS TO AND FROM EACH HOUSING
ON AVENUE C CONNECTION, EAST OF MAIN STREET
(From counts for this analysis,
data in Attachment D)



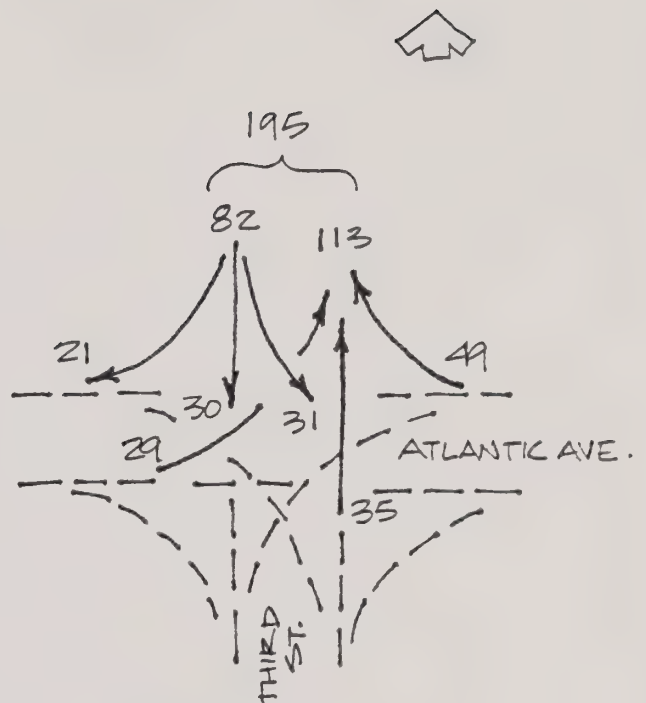
COUNT 1B
4:30-5:30 P.M., FRIDAY



COUNT 1C
5:00-6:00 P.M., THURSDAY



COUNT 1D
4:15-5:15 P.M., FRIDAY



AVERAGE OF
P.M. PEAK HOUR COUNTS
1B, 1C AND 1D.

FIGURE 14

P.M. PEAK HOUR TRAFFIC COUNTS
TRIPS TO AND FROM EAST HOUSING
ON THIRD STREET AT ATLANTIC AVENUE
(From counts for this analysis,
data in Attachment D)

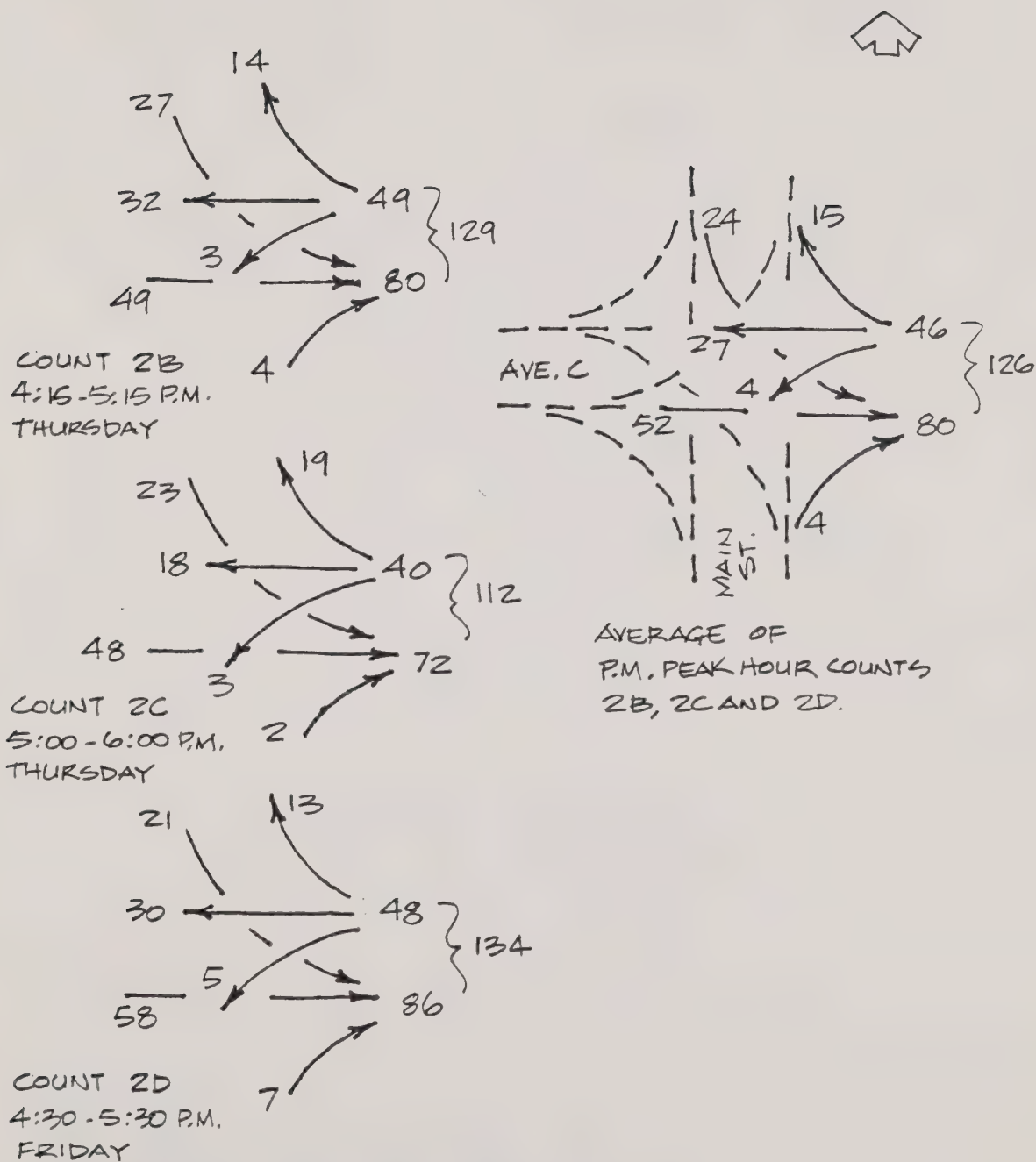
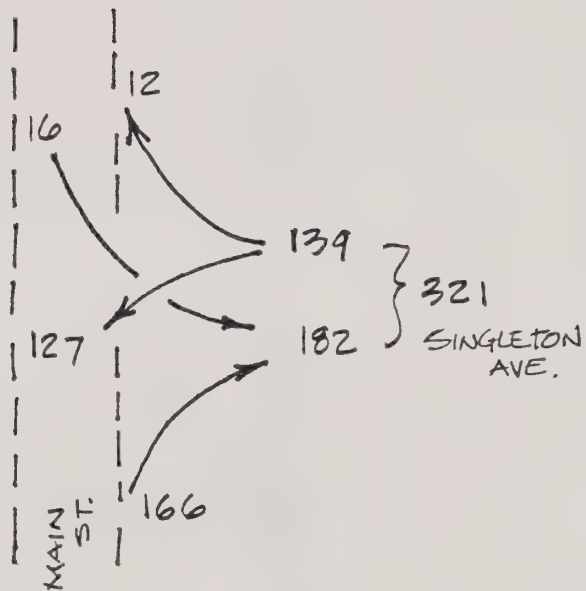


FIGURE 15

P.M. PEAK HOUR TRAFFIC COUNTS
TRIPS TO AND FROM EAST HOUSING
ON AVENUE C CONNECTION, EAST OF MAIN STREET
(From counts for this analysis,
data in Attachment D)



COUNT 3

5:00 - 6:00 P.M., WEDNESDAY

FIGURE 16

P.M. PEAK HOUR TRAFFIC COUNT
TRIPS TO AND FROM NORTH HOUSING
ON SINGLETON AVENUE AT MAIN STREET
(From counts for this analysis,
data in Attachment D)

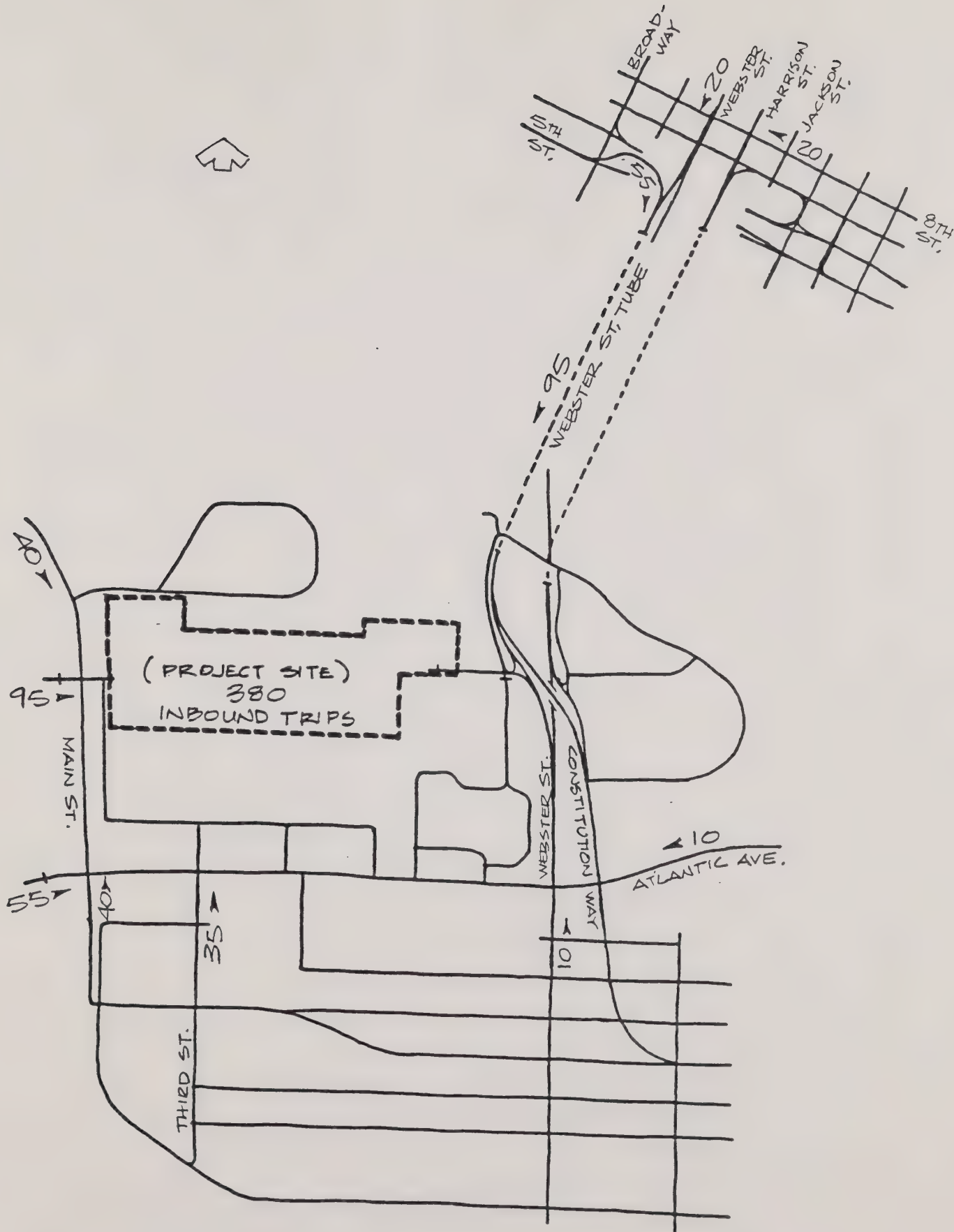


FIGURE 17

INBOUND P.M. PEAK HOUR VEHICLE TRIPS TO PROJECT SITE
(Estimate based on 960 new housing units.)

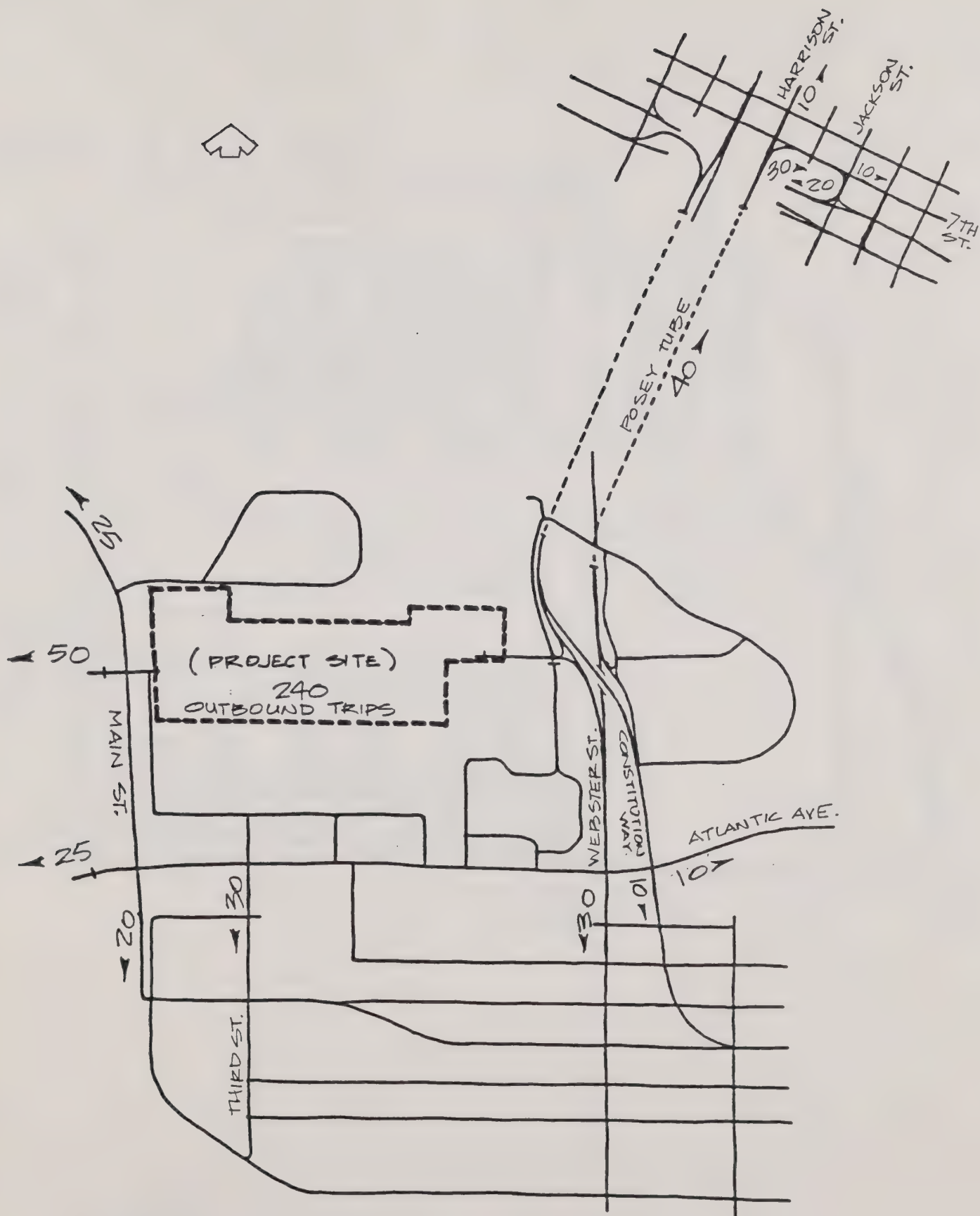


FIGURE 18

OUTBOUND P.M. PEAK HOUR VEHICLE TRIPS FROM PROJECT SITE
(Estimate based on 960 new housing units)

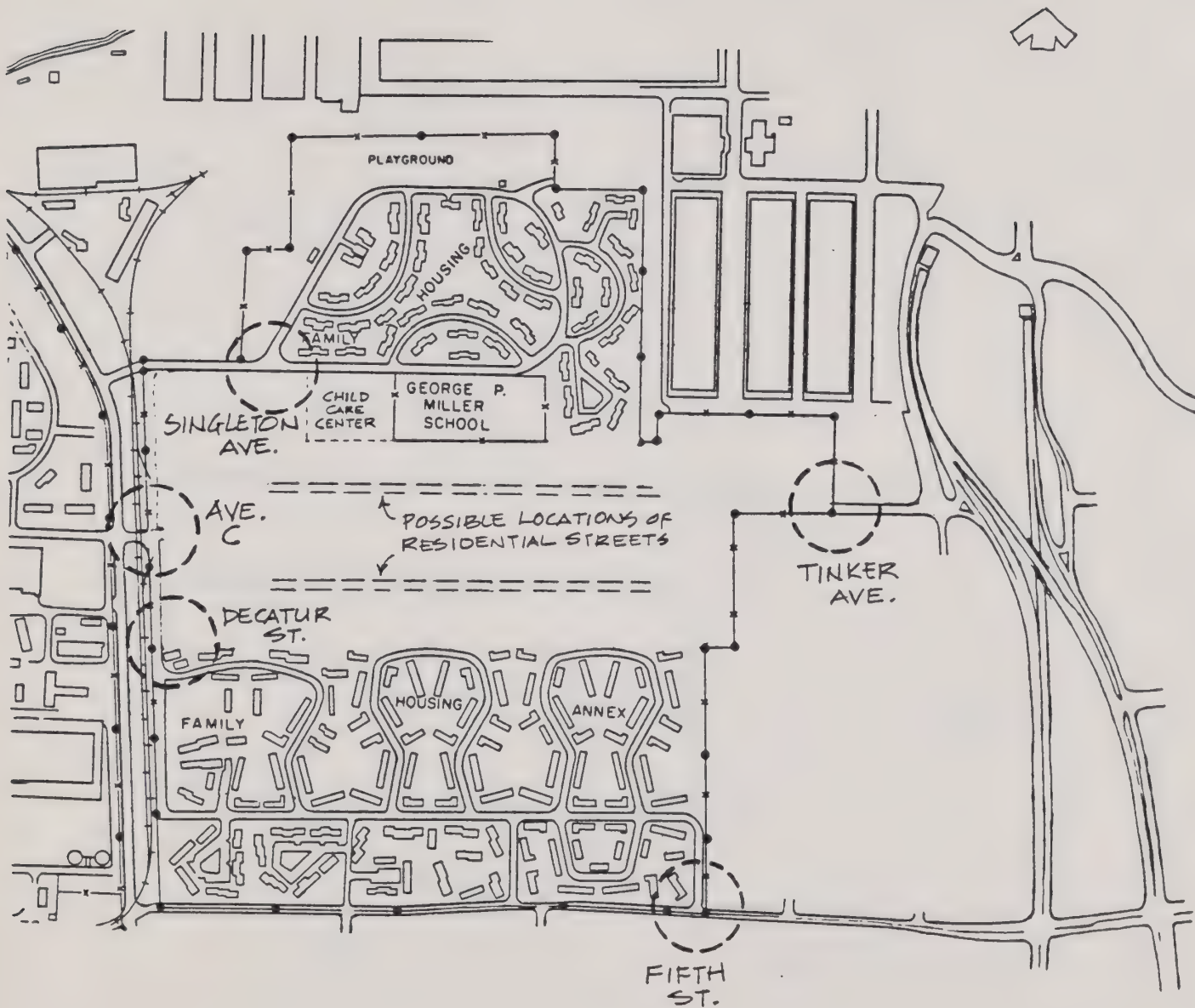


FIGURE 19

POSSIBLE POINTS OF ACCESS
AND TENTATIVE INTERNAL STREET LOCATIONS
FOR PROJECT SITE

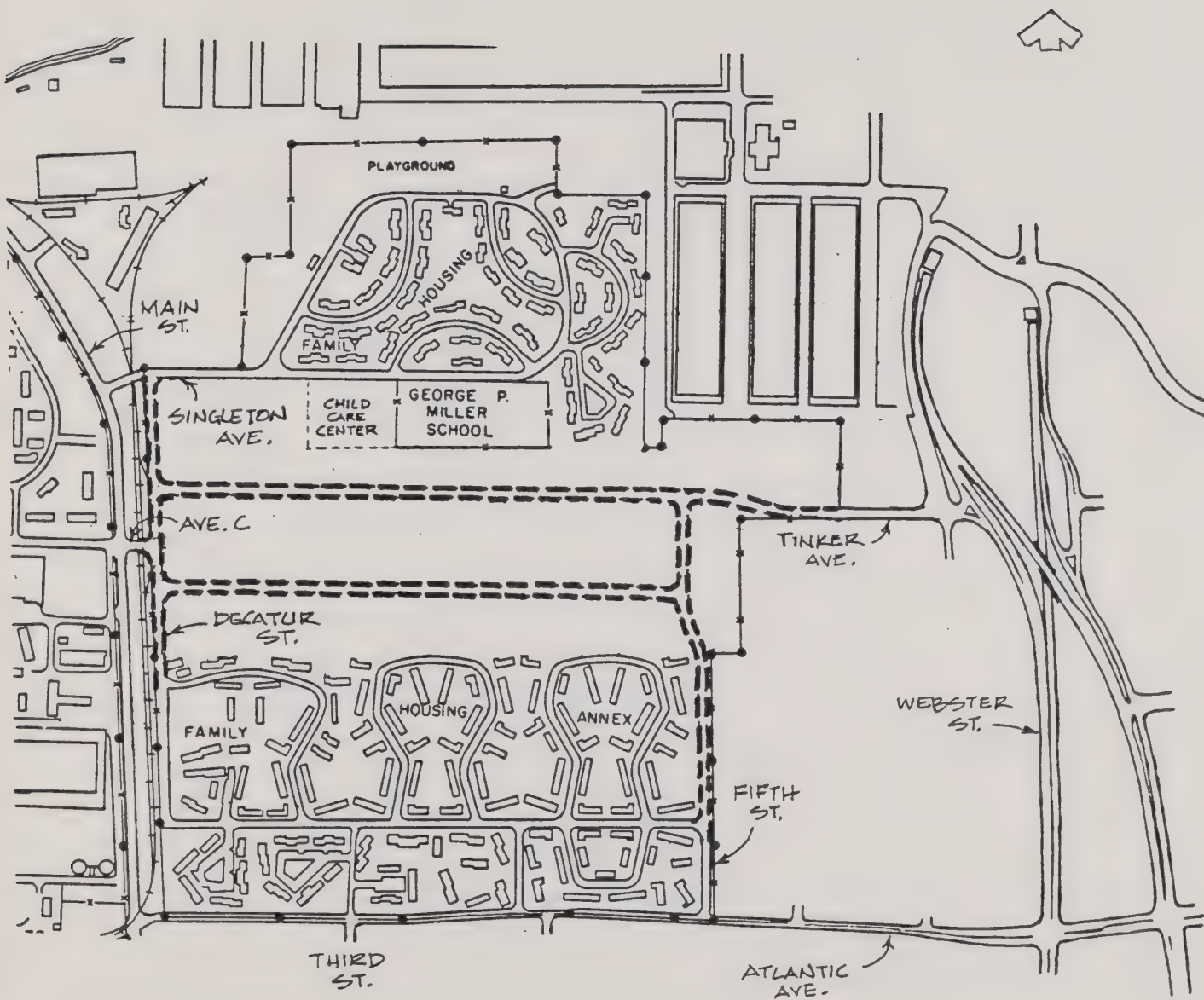


FIGURE 20
ACCESS SCHEME 1(A)

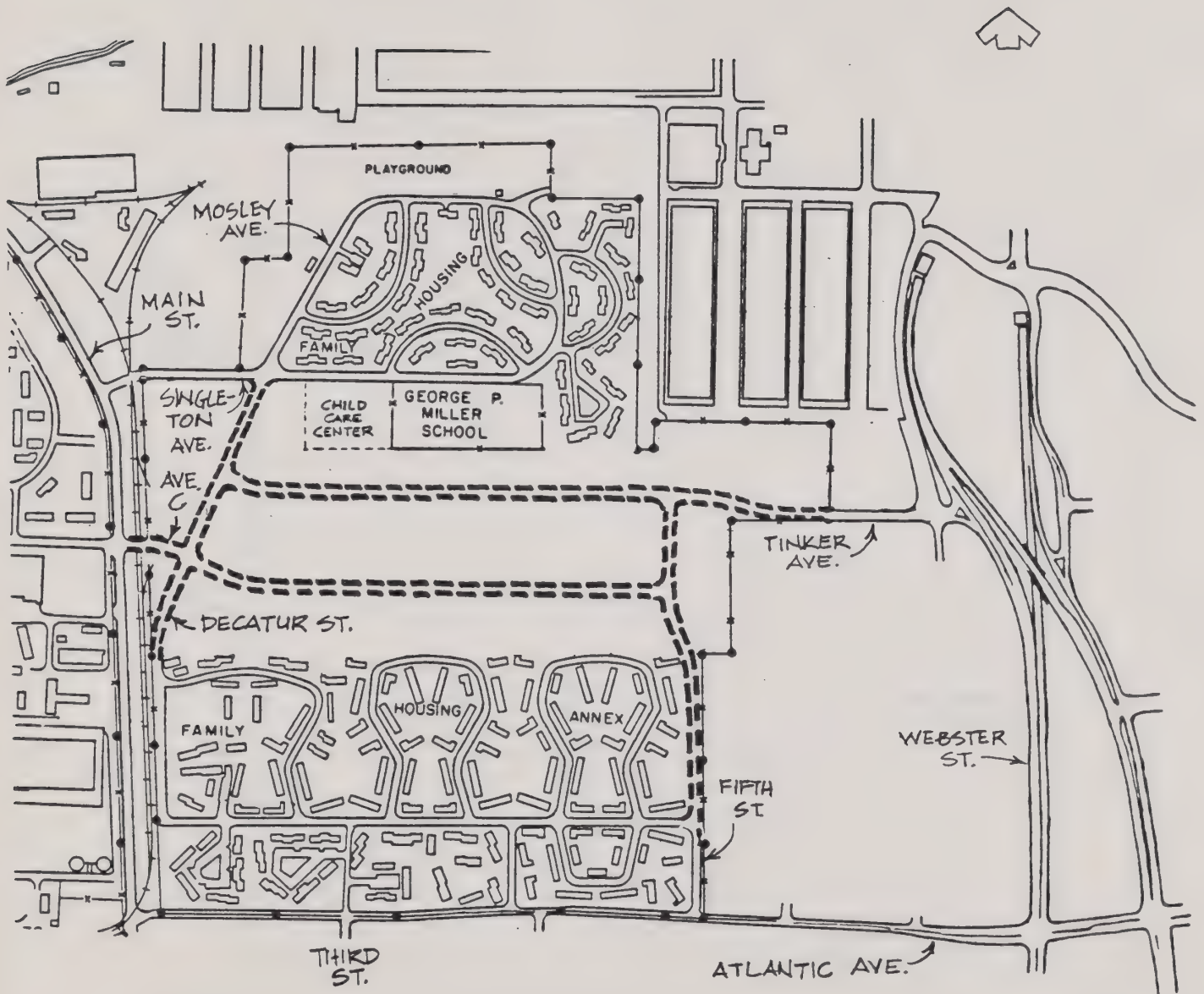


FIGURE 21
ACCESS SCHEME 1(B)

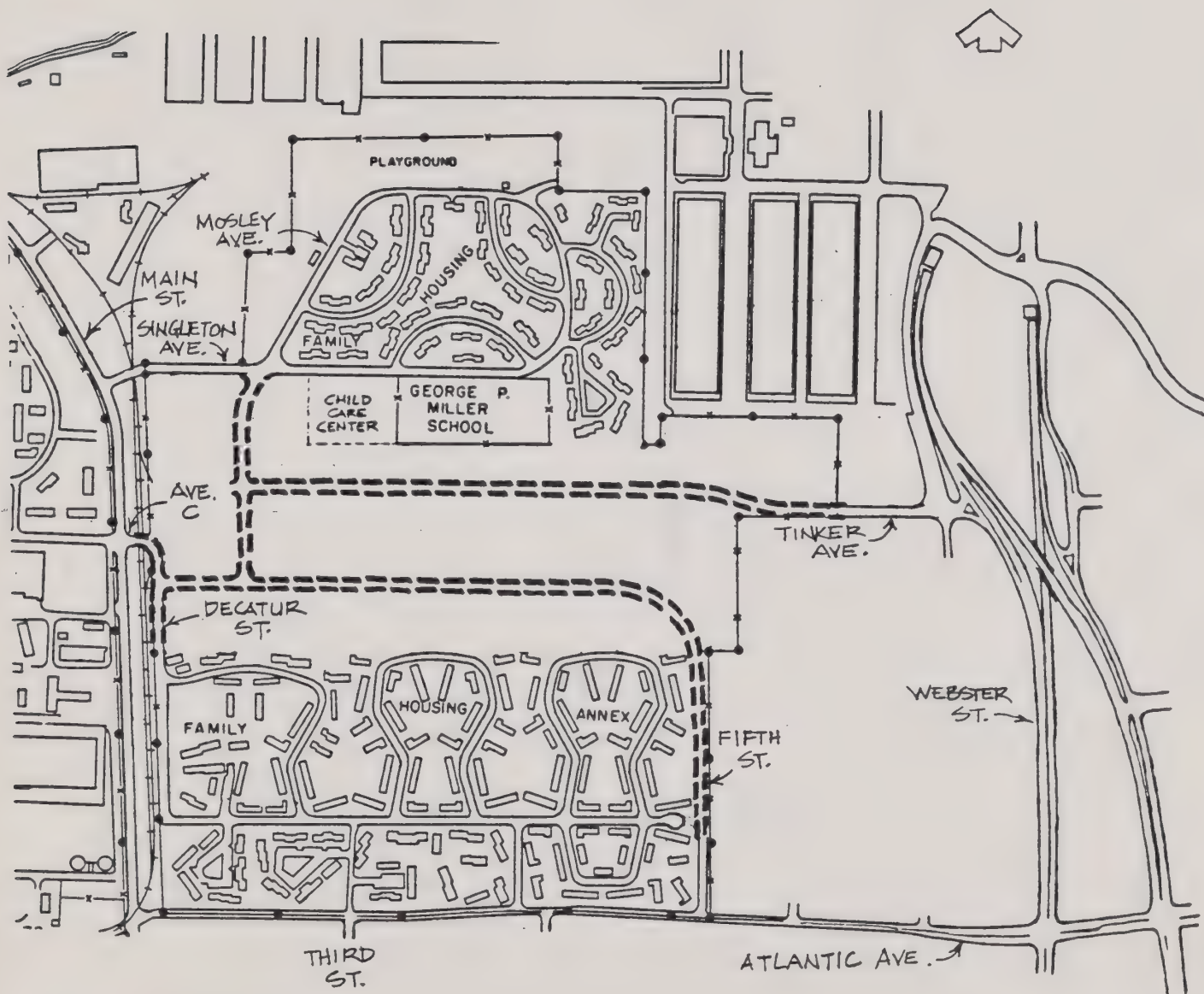


FIGURE 22

ACCESS SCHEME 1(C)

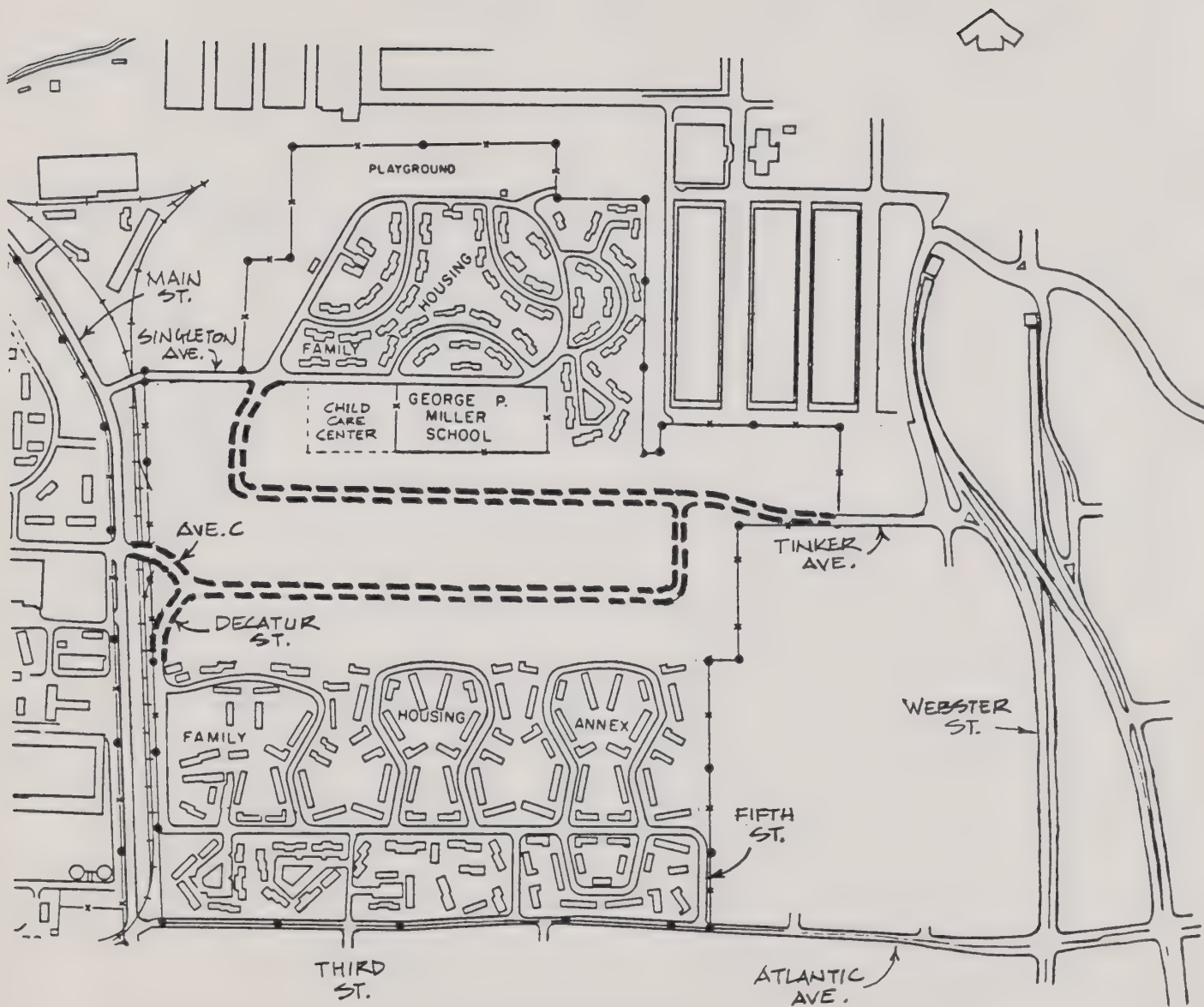


FIGURE 23
ACCESS SCHEME 2(A)

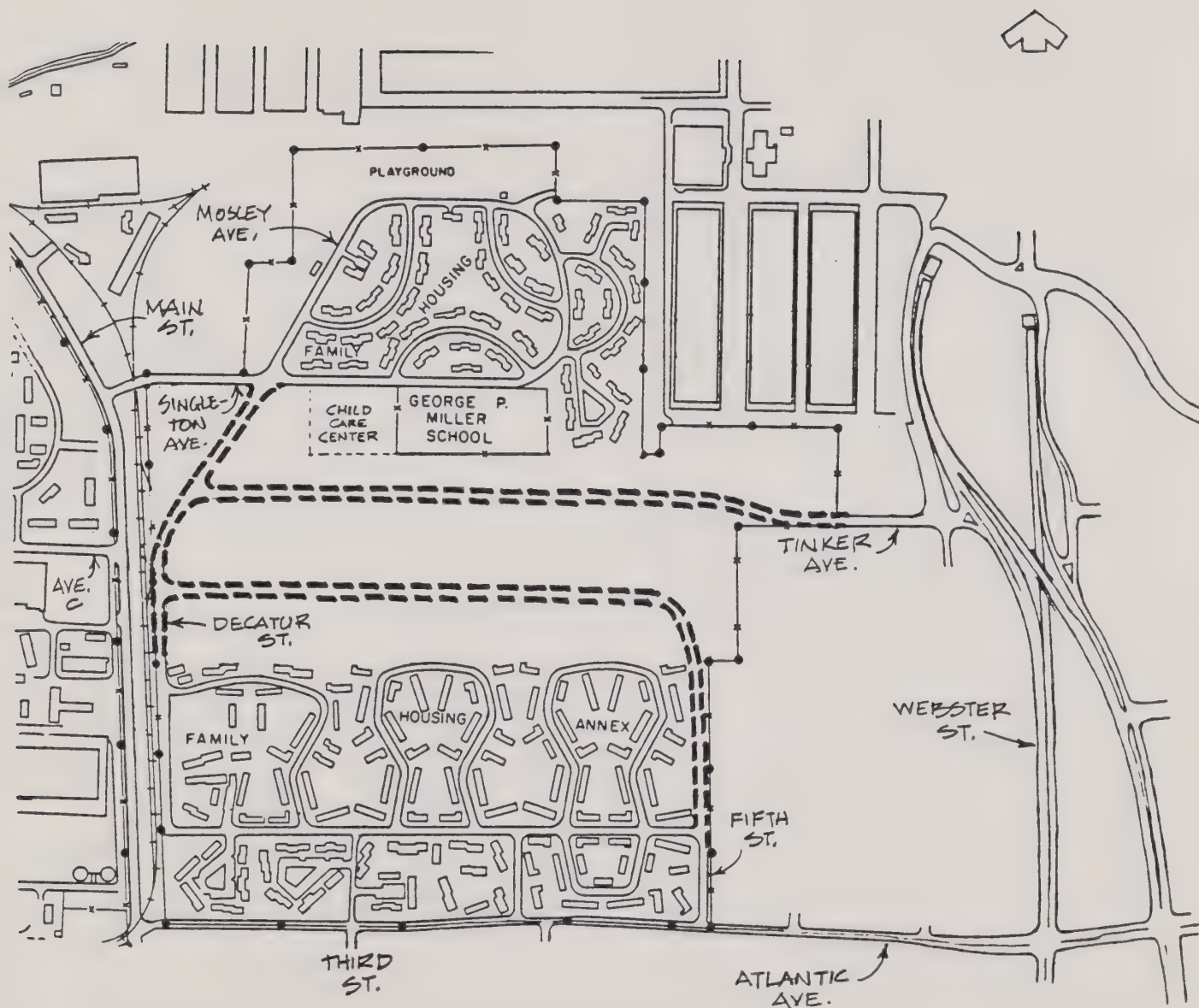


FIGURE 24
ACCESS SCHEME 3(A)

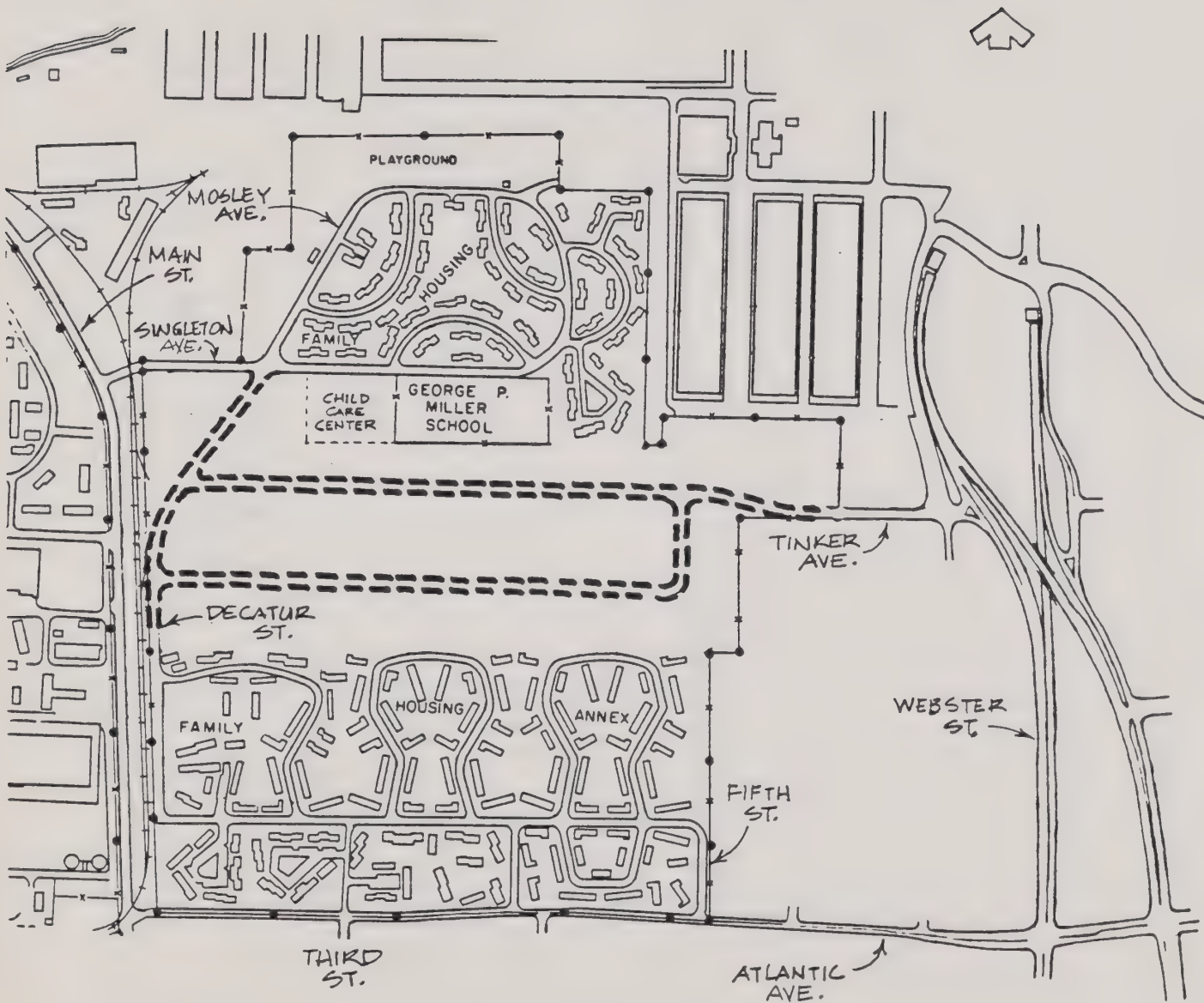


FIGURE 25

ACCESS SCHEME 4 (A)

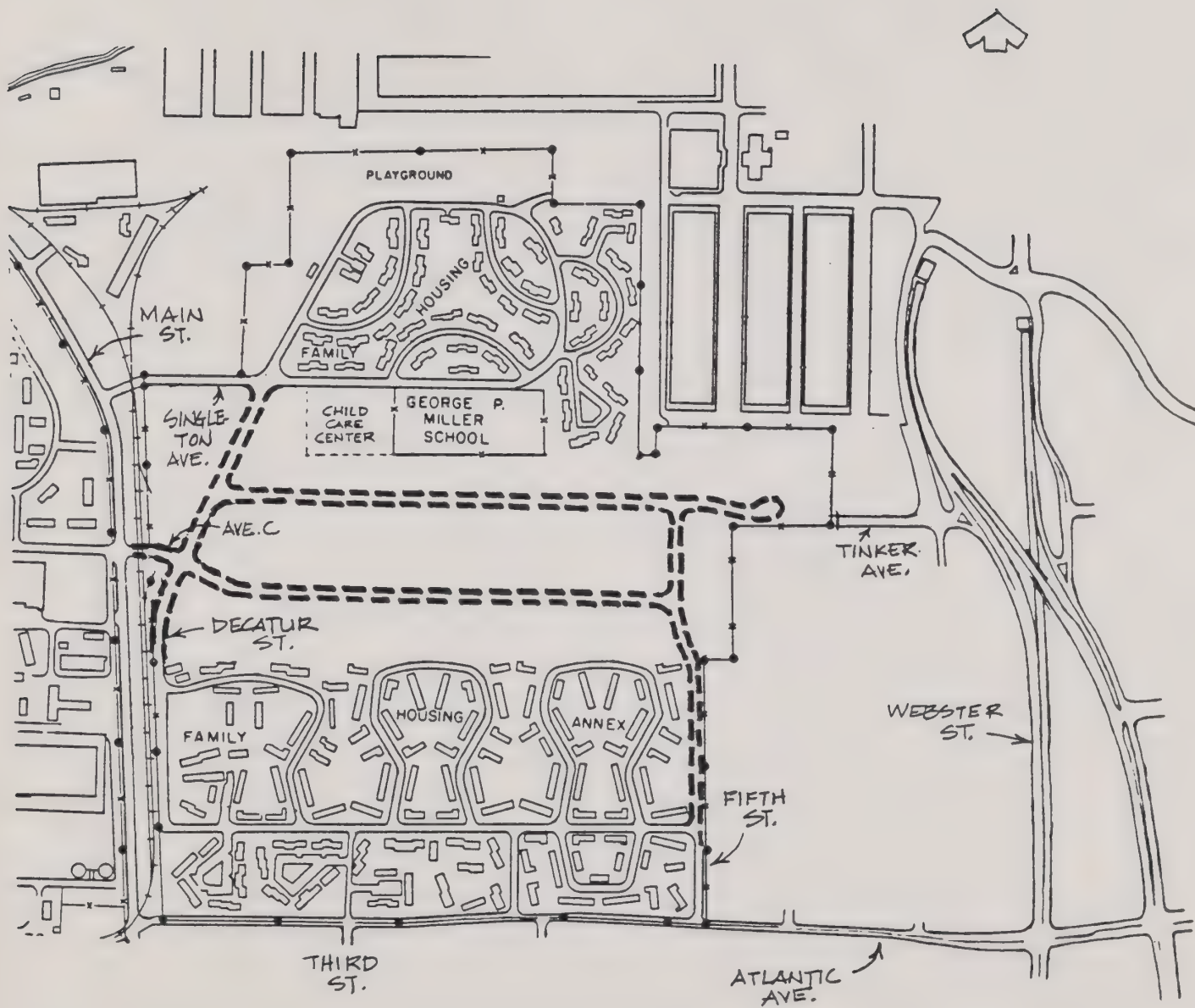


FIGURE 26
ACCESS SCHEME 5 (A)

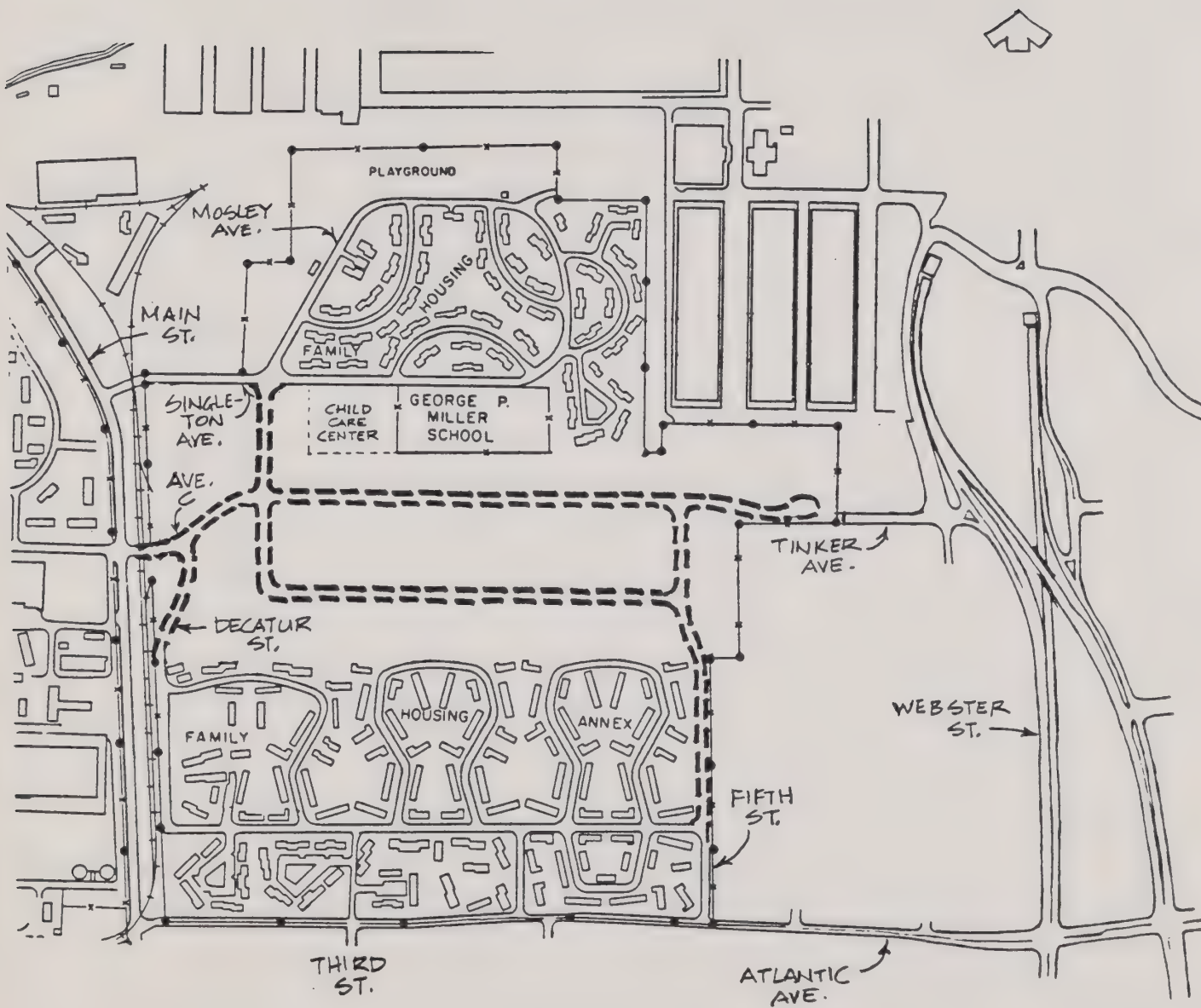


FIGURE 27
ACCESS SCHEME 5(B)

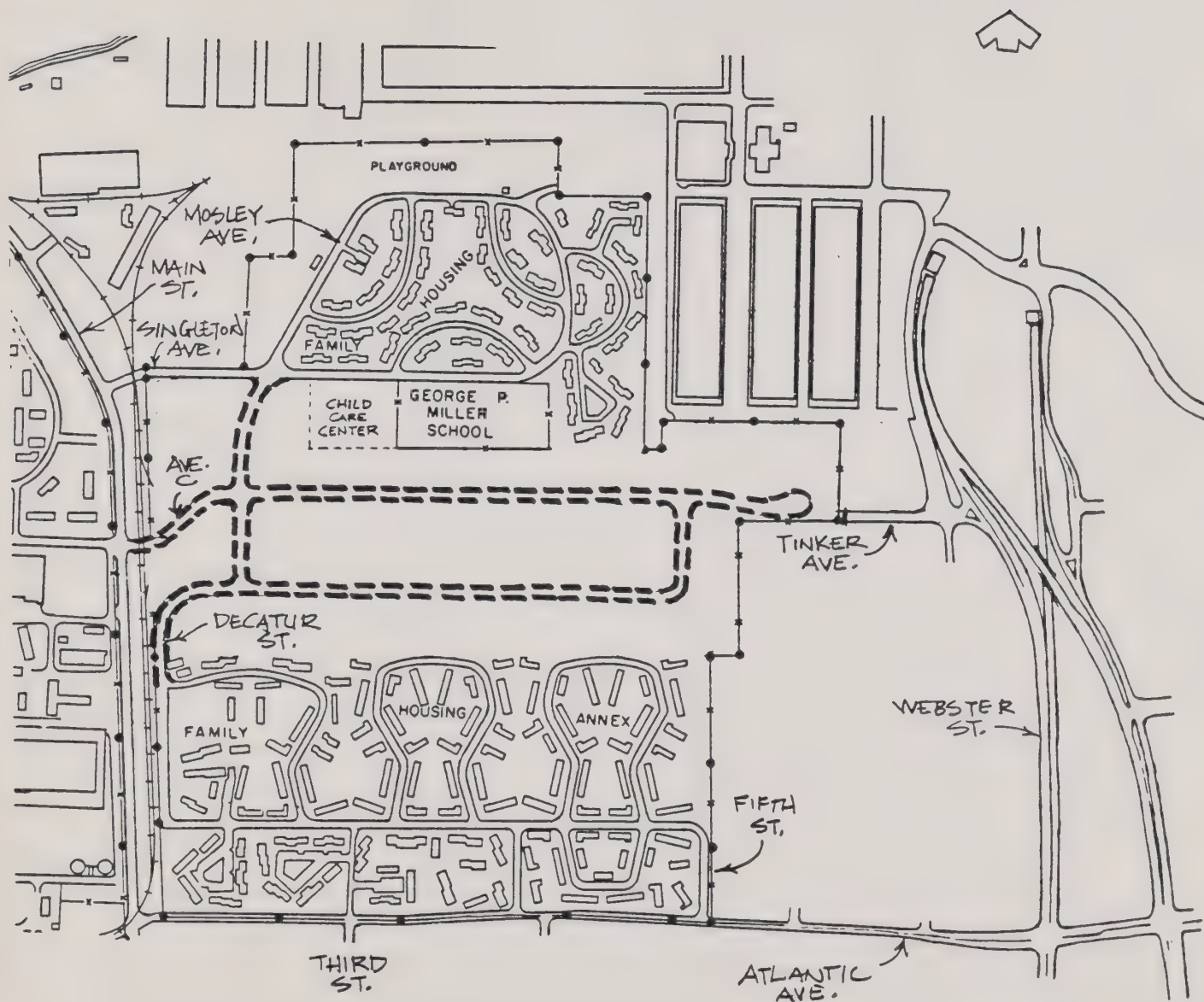


FIGURE 28
ACCESS SCHEME 6(A)

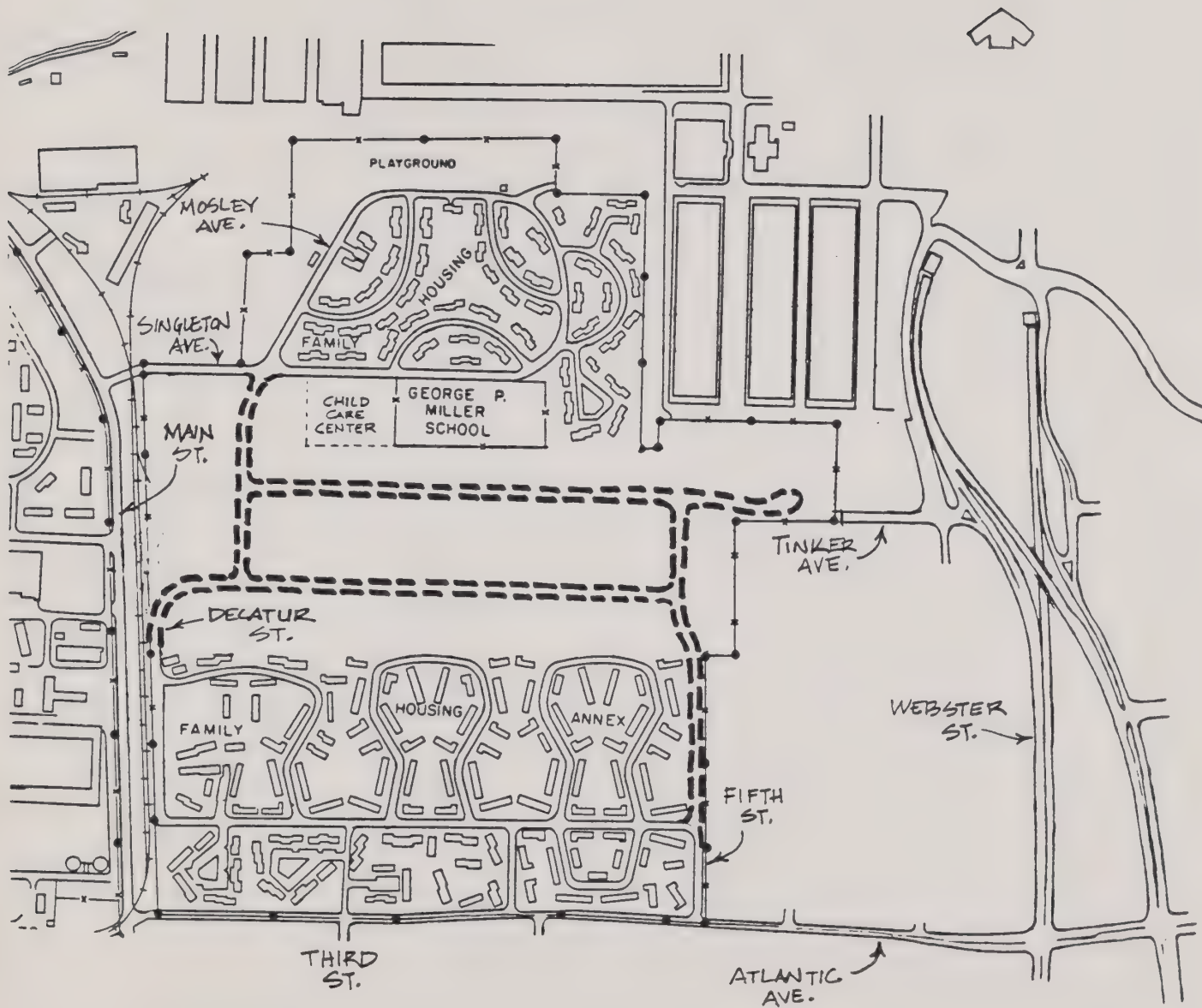


FIGURE 29
ACCESS SCHEME 7

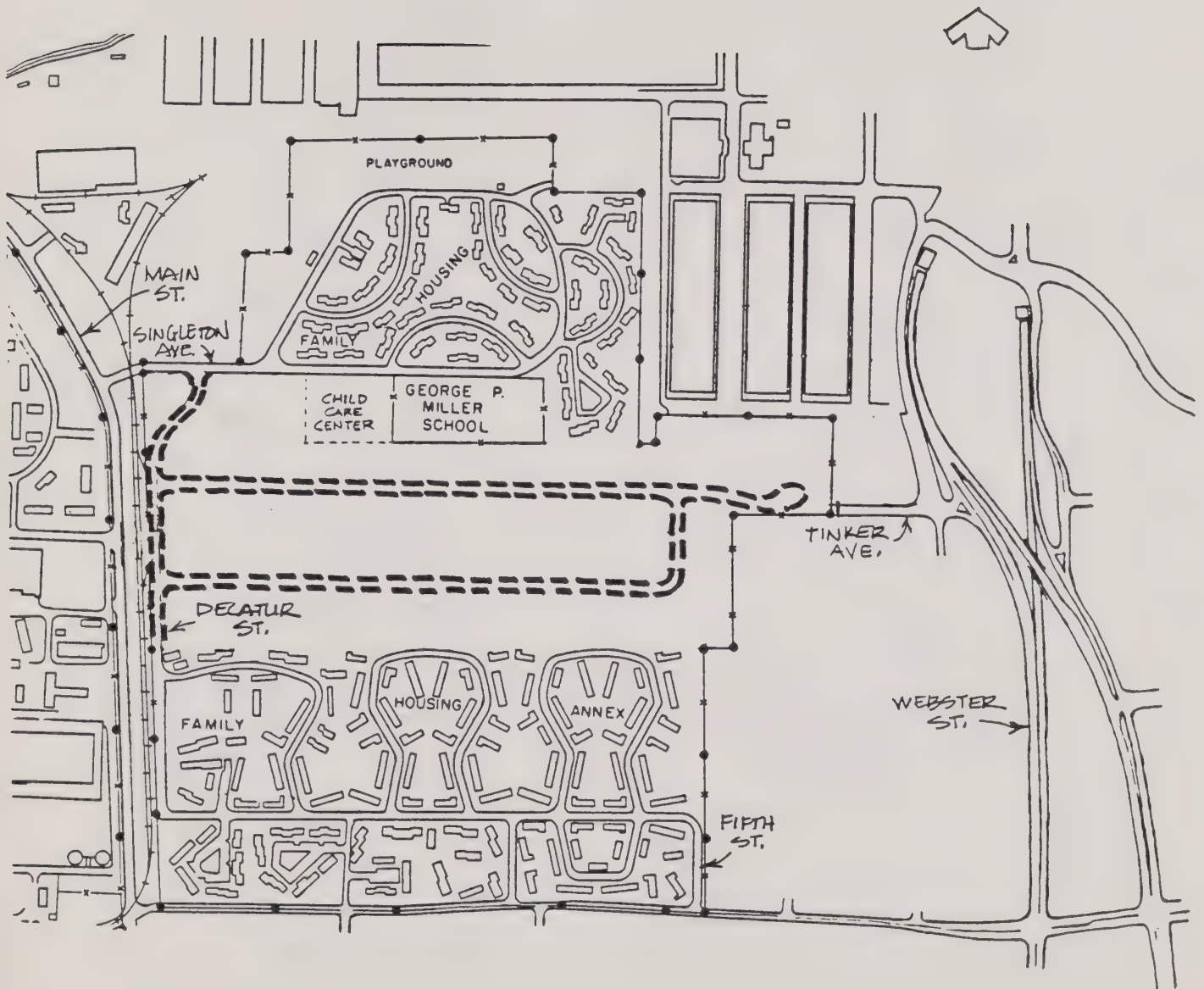
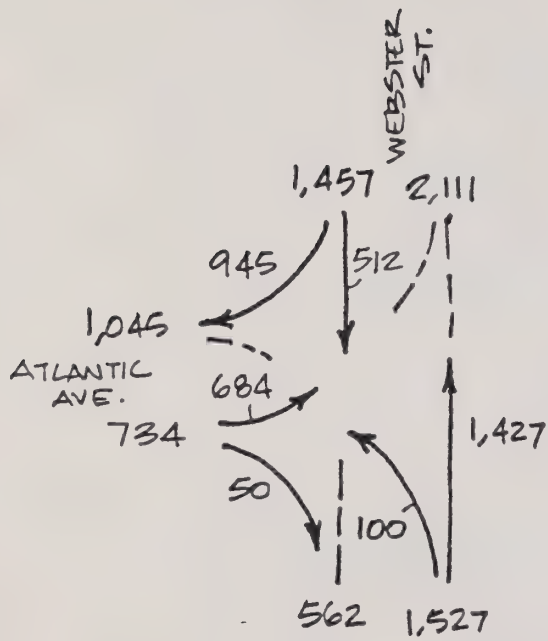
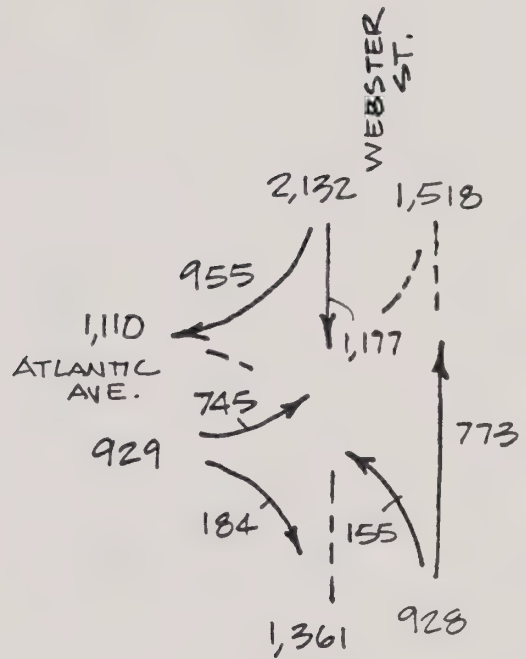


FIGURE 30
ACCESS SCHEME 8



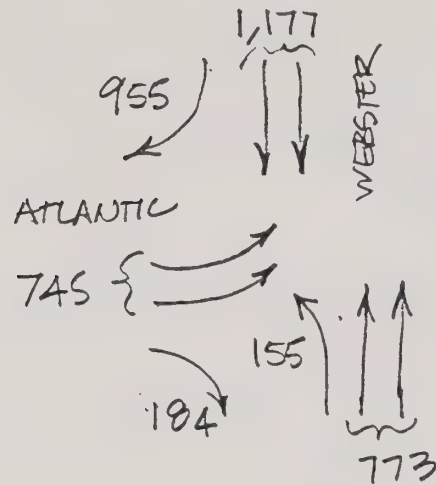
COUNT 6A
7:00 - 8:00 A.M.
TUESDAY



COUNT 6B
4:45 - 5:45 P.M.
TUESDAY

FIGURE 31
PEAK HOUR TRAFFIC COUNTS
ATLANTIC AVENUE AND WEBSTER STREET
(Counts made for this analysis, Attachment D)

DIAGRAM OF VOLUMES AND LANES



CALCULATION OF CRITICAL LANE VOLUMES BY SIGNAL PHASE :

PHASE	LANES	VOL./LANES	VOL. PER LANE (CVPL)
I	↓ ↓	$\frac{1,177}{2}$	= 589
II	↑	$\frac{745}{2}$	= 373
III	←	$\frac{155}{1}$	= $\frac{155}{1,117}$

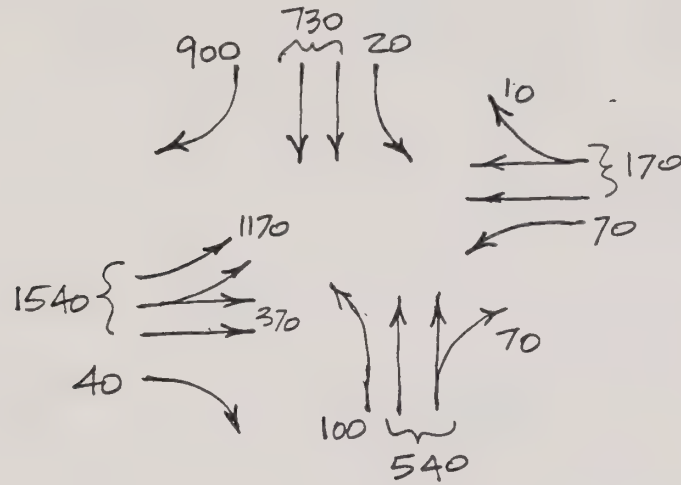
CAPACITY (E) FOR 3-PHASE SIGNAL = 1,425

VOL.-TO-CAPACITY RATIO = $\frac{1,117}{1,425} = 0.78$, LEVEL C

FIGURE 32

LEVEL OF SERVICE CALCULATION
ATLANTIC AVENUE AND WEBSTER STREET
EXISTING CONDITIONS

DIAGRAM OF VOLUMES AND LANES



CALCULATION OF CRITICAL LANE VOLUMES BY SIGNAL PHASE:

PHASE	LANES	VOL./LANES	VOL. PER LANE (VPL)
I	↓ ↓	$\frac{730}{2}$	= 365
II	→ →	$\frac{1170}{2}$	= 585
III	← ←	$\frac{170}{2}$	= 85
IV	←	$\frac{100}{1}$	= 100
			1,135

CAPACITY (C) FOR 4-PHASE SIGNAL = 1,375
 VOL.-TO-CAPACITY RATIO = $\frac{1,135}{1,375} = 0.83$, LEVEL D

FIGURE 33

LEVEL OF SERVICE CALCULATION
 ATLANTIC AVENUE AND WEBSTER STREET
 FUTURE CONDITION WITHOUT NAVY HOUSING PROJECT

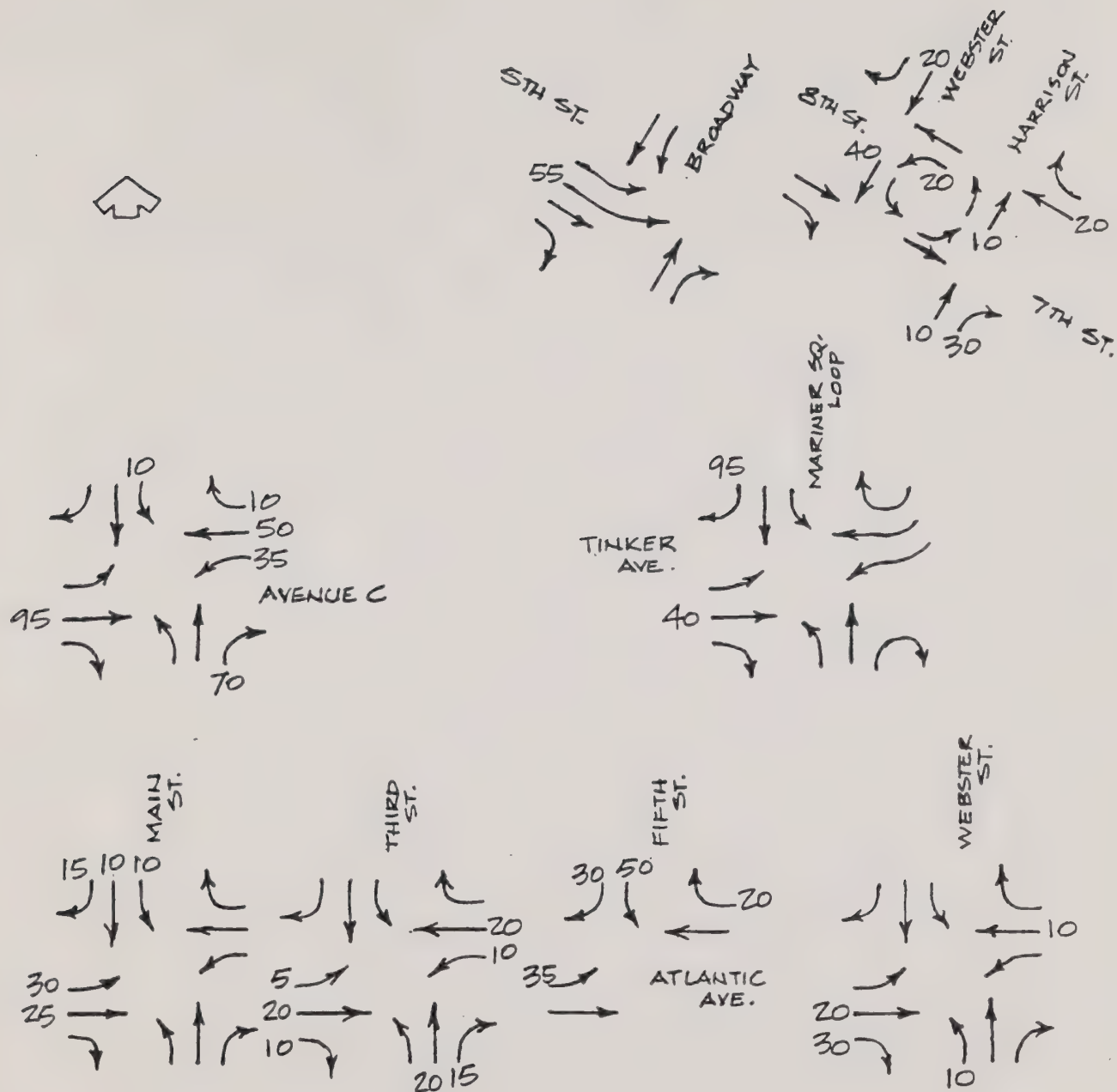


FIGURE 34

P.M. PEAK HOUR TRAFFIC VOLUMES
 ADDED TO PRINCIPAL INTERSECTIONS
 BY NAVY HOUSING PROJECT AND ACCESS SCHEME 1(C)

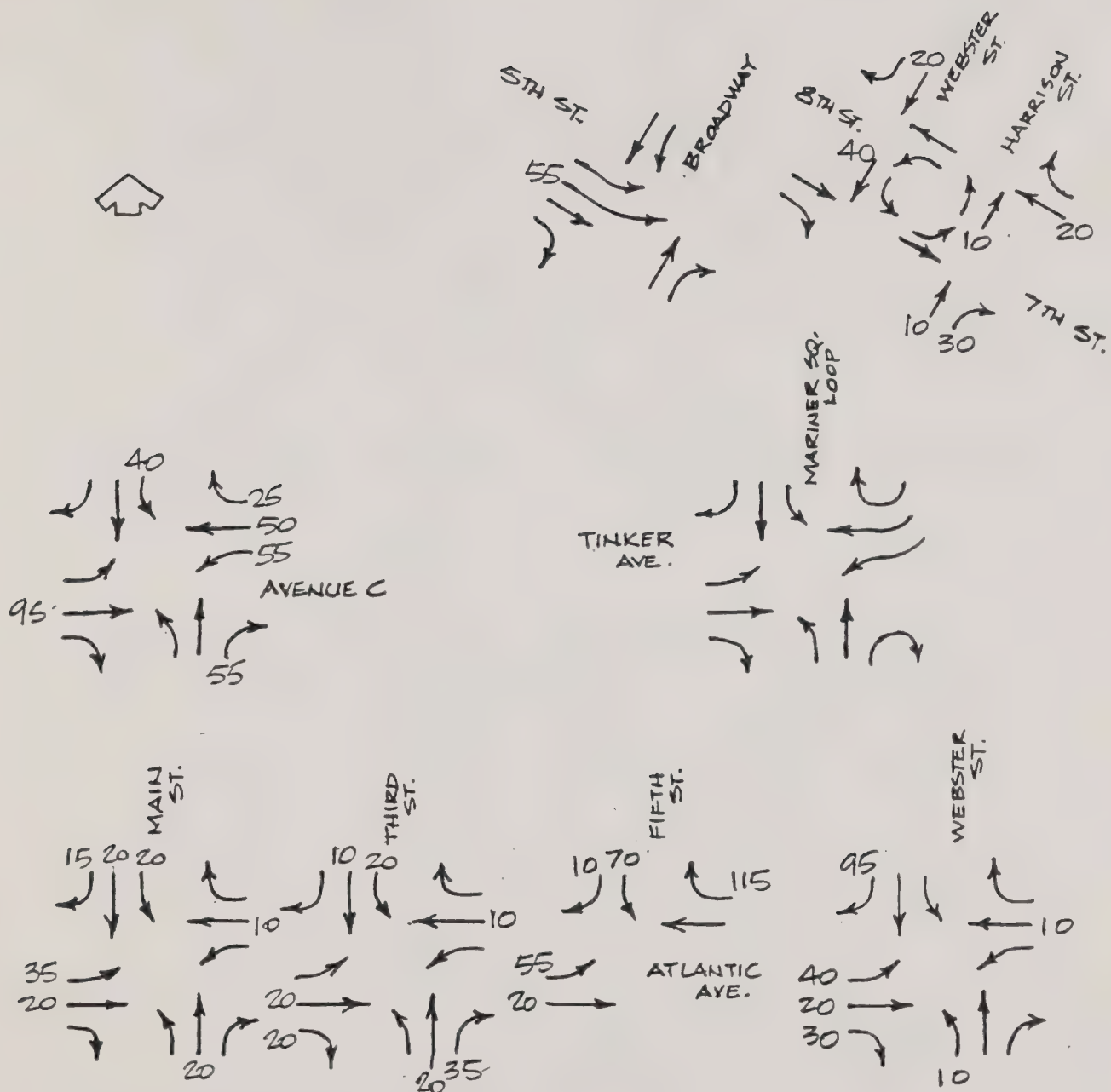


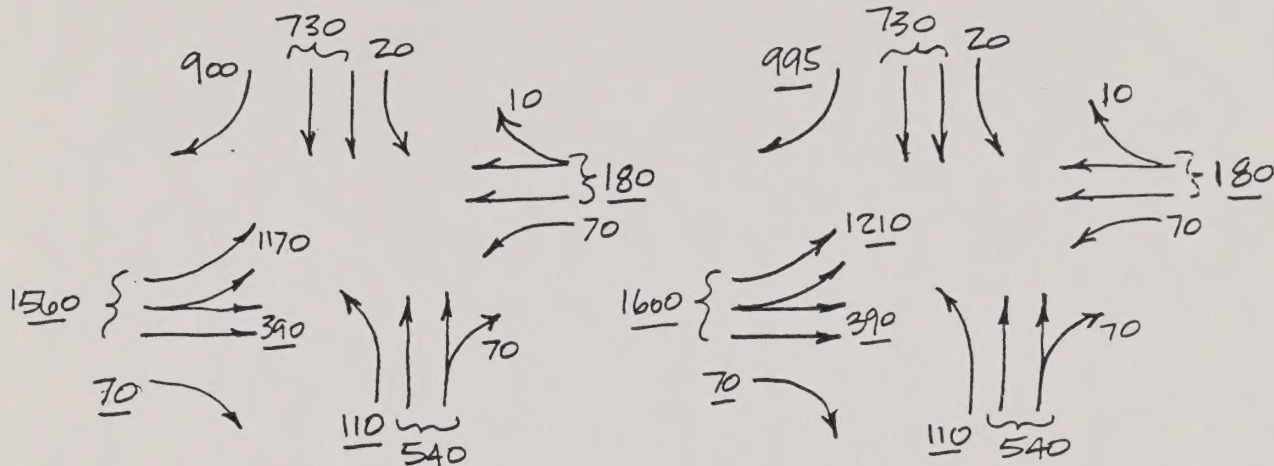
FIGURE 35

P.M. PEAK HOUR TRAFFIC VOLUMES
 ADDED TO PRINCIPAL INTERSECTIONS
 BY NAVY HOUSING PROJECT AND ACCESS SCHEME 5 (A)

DIAGRAMS OF VOLUMES AND LANES:

FOR SCHEME 1(C)

FOR SCHEME 5(A)



CALCULATION OF CRITICAL LANE VOLUMES, BY SIGNAL PHASE

PHASE	LANES	SCHEME 1(C)		SCHEME 5(A)	
		VOL/LANES = VPL		VOL/LANES = VPL	
I	↓ ↓ ↓	$\frac{730}{2}$	= 365	$\frac{730}{2}$	= 365
II	↙ ↘	$\frac{1170}{2}$	= 585	$\frac{1210}{2}$	= 605
III	← ←	$\frac{180}{2}$	= 90	$\frac{180}{2}$	= 90
IV	←	$\frac{110}{1}$	= 110	$\frac{110}{1}$	= 110
		<u>1,150</u>		<u>1,170</u>	

CAPACITY (C) FOR 4-PHASE SIGNAL = 1,375

VOL-TO-CAPACITY RATIOS:

$$\text{SCHEME 1(C): } \frac{1,150}{1,375} = 0.84, \text{ LEVEL D}$$

$$\text{SCHEME 5(A): } \frac{1,170}{1,375} = 0.85, \text{ LEVEL D}$$

FIGURE 36

LEVEL OF SERVICE CALCULATIONS
 ATLANTIC AVENUE AND WEBSTER STREET
 FUTURE CONDITIONS WITH NAVY HOUSING PROJECT
 COMPARING ACCESS SCHEMES 1(C) and 5(A)

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